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THE

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(J. A. BERLY'S).

1911 EDITION

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LIVE STEAM FEED HEATING.

MANY steam engineers have for long agreed that an actual economy attaches to the use of live steam for heating feed water, and some have advocated its use for the purpose of adding the last few degrees after waste steam or economisers have done their share. Members of this school say that water should enter the boiler at the temperature proper to the steam pressure, only the heat necessary for evaporation being taken up there. They do not base their belief on any ridiculous idea of getting out of such live steam more than it contains: they merely regard the operation as one which conduces to a better heat transmission efficiency of the boiler surfaces. Other engineers have scorned the idea, and in 1908 Messrs. Bilborough and MacLachlan wrote a paper and proved to their own satisfaction that no such economy was possible. Now in the *Engineer* Prof. Gibson shows that those two gentlemen neglected certain precautions which they ought to have taken, and that the results they obtained and which were made to appear adverse to the theory were really confirmatory of it, and that live steam feed heating is distinctly beneficial. No engineer has ever claimed more than, say, 5 per cent. superior efficiency, and this is difficult to show experimentally, because of the various factors which operate.

In commenting on the article of Prof. Gibson, our contemporary points to a test made with a Kirkaldy heater on the steamer *Oriole* some years ago. It was observed that when the live steam heater was set in operation without the knowledge of the firemen, the latter could easily keep up steam to 95 lb. pressure, while without it they had hard work to keep it up to 90 lb. This, of course, if repeated often is pretty good evidence, but, on the other hand, it is easy to say that the steam might have dropped to 90 lb., and once it got there the engines would use so much more as would necessarily tax the firemen more. Now Prof. Gibson, with the plant at University College, Dundee, shows a benefit of 8 per cent. from live steam heating. Obviously the same additional efficiency should attach to all full-temperature heating in addition to the mere economy of heat units that would otherwise be wasted. Thus, if a feed heater shows 15 per cent. in heat units saved out of the chimney gases, the real saving of fuel ought to be 20 or 22 per cent.

It is certain that hot feed is a great help. All practice favours hot feed for many reasons, which lend themselves to keeping steam pressures up, with the resulting efficiency of high pressure, which alone may explain everything. But Prof. Gibson made his tests carefully and employed for live steam heating merely three trays inside the steam space of the boiler. He used the same boiler for both sides of the experiment, and he finds a saving of 5 per cent. for light loads and 8 per cent. for heavy loads. That the saving is due to the greater efficiency of the heating surface when the feed is hot does not appear to be doubted, but an experiment was made with a gas ring and a cast-iron boiler and showed superior heat transmission with the hotter feed supply. All experience, of course, points to the desirableness of feed heating to the maximum temperature of the

steam, and it is satisfactory to learn that Dr. Gibson finds that an actual economy of fuel should be obtained. If this belief becomes general, fully-heated feed will become popular, and it will save its cost in repairs even if there is no economy of fuel.

The opinions expressed by writers in these columns are mostly in favour of live steam heating if the feed still lacks anything of boiler temperature. But, unless for some special object connected with scale, it is not easy to see why the internal tray apparatus should not be fully competent to do all that is wanted. The one thing needful is apparently to keep cold water off the boiler surfaces, or their heat transmitting efficiency will be reduced. Probably Dr. Gibson's work will lead others to pay attention to the same subject, and further prove or disprove his conclusions, for it cannot be said that sufficient tests have yet been made to settle the question finally. The distinguished French engineer Normand was a strong advocate of live steam heating, on account of its economy among other reasons.

With so much in its favour it would appear that there must be an economy, but, as stated above, much may have arisen out of the single fact that when a cold feed does lower steam pressure, it is so hard to get it back again. Dr. Gibson appears to have carried out his tests in the right way, for, except for the trays, he put cold feed *inside* the boiler in both tests. Only the trays were there to make any difference, and this is a very striking point.

Electricity in Collieries.

At Staveley on Monday last, Mr. F. Hall, treasurer of the Derbyshire Miners' Association, addressing a large audience of miners, referred in emphatic terms to the risks incurred through miners carrying matches and tobacco into the mines. Mr. W. E. Harvey, M.P., at the same meeting, made an attack upon electricity in mines, alleging that the West Stanley and Lancashire explosions were due to its use, and declaring that if it were proved that the pits could not be worked with electrical machinery without danger to the men, it would have to go out altogether, or the pits would have to stand idle. Both speakers were agreed that more inspectors were required.

Now, the evidence given at the inquest on the victims of the Little Hulton Colliery explosion by the Government Inspector and others has already proved conclusively that electricity could not have been the cause of the disaster, as shown in our report last week.

The Whitehaven explosion occurred in a pit not even equipped with electrical apparatus, and numerous other instances could readily be quoted of disastrous explosions in pits where electricity had never been employed. Yet, because explosions continue to occur after as well as before the introduction of electricity, the miners' representatives seize upon its use as accounting for them, and obstinately adhere to their hypothesis in the face of the most convincing evidence of independent experts.

The *Colliery Guardian*, in its last issue, took occasion to lay stress upon the frequency with which matches are taken into coal mines by the men, in flagrant disregard of the frightful risks thus incurred, which involve not merely themselves but also hundreds of their fellows; and in support of its animadversions upon the "criminal and heartless conduct" of those who are guilty of the practice, our contemporary gives a list of no fewer than 24 recent convictions recorded in the short space of two weeks, mainly for carrying matches, but in three cases for opening lamps, and in two cases for actually *smoking!* In 1909 there were 211 such convictions, and be it noted that these figures take no account of the number of cases in which similar acts are committed without detection —probably a far greater number.

Our contemporary proceeds to discuss the subject on its own merits in scathing terms; we, however, are more directly concerned with its bearing upon the safety of electrical machinery in coal mines. In view of the wide prevalence of the evil referred to, it is little short of astonishing that the miners' leaders should have the assurance to attribute to electricity every explosion in a mine electrically equipped, no matter how remote the probability of its being blameworthy. Let them cast out the beam in their own eye before attempting to deal with the mote in their neighbour's. So long as explosions occur in non-electrified pits, and miners are proved to carry matches—aye, and to leave them lying about—in fiery mines, it is absurd to cast the blame invariably upon the customary scapegoat—the electric spark.

Foreign Trade: Baron Furness advocates a Big National Policy.

The Foreign Trade Returns for the month of January show that the improvement continues. As compared with the corresponding month of last year, the figures were :—

Imports, £62,694,771	...	Increase, £6,785,087
Exports, £37,730,831	...	„ £2,927,716
Re-exports, £8,641,472	...	„ £494,308

The electrical goods imported advanced by £16,334 to £109,471, and the electrical goods exported went up by £47,922 to £202,996. Machinery imported advanced by £99,903 to £433,719; and that exported increased by £385,330 to £2,486,083. In iron and steel manufactures exported there is also an improvement of £351,815.

While drawing attention to these results, we would also mention an important letter from Baron Furness on "The Commercial Future of Great Britain," which appears in Wednesday's *Times*. The writer shows that he is alive to the keenness of German competition, that he regards the "Wake up England!" cry as still needed, and that he speaks with the experience of one who has been "going about the world for 40 years," and who still goes "in order to bring orders home." Writing as a convinced Free Trader, he says: "I state deliberately that unless we apply ourselves assiduously and nationally to develop our commercial methods on the highest possible plane, we cannot hope to hold our own—it would be a natural impossibility." Generally when we agree with the "Wake up" cry, "we mean that some other body is to wake up." "The idea of world-wide trade dominion is not an enthusiasm with us." "For an overmastering and consuming passion to capture trade on scientific lines one has to look elsewhere." "Our concern should be our own neglect of any real method—our disregard of any scientific and highly organised system—our lack of any purposeful and insistent campaign."

The reader knowing the Electrical Review's trade policy, and its persistent advocacy of a world-wide trade campaign, of the over-mastering passion to capture trade, of sending British engineer-traders to compete against German engineer-traders, will not be surprised that we quote these criticisms of Baron Furness with strong approval. We are convinced that this policy indicates *the* way, the *only* way, along which a great improvement in British engineering, electrical, and other trade lies so far as one can judge from what one observes at the moment. The distinguished *Times* writer argues, as the Electrical Review and many others have done, for a Minister of Commerce. Why have we not had one for years past instead of being content with a Board of Trade President, who has to cover a multitude of matters?

"Something of the energy we devote as a nation to the defence of our hearths and homes should be directed, and quite as nationally to the preservation and extension of our commerce." Agreed! But what is to be the next step? We trust that the letter will be read by those in positions of authority who will be prepared to pay a greater regard to national trade expansion interests, but we also hope that Baron Furness's views will have the support of manufacturers and traders who may in some organised way be able to bring pressure to bear upon the Government. When trade was bad there was a great deal said about devising means for

filling in the depressions in the trade curve. Now things are better we do not witness anxiety to prepare for or to avoid the next depression. Shall we wait for it to come and then discuss again ?

New Zealand Hydro-Electric Development.

A few weeks ago we referred in these columns to the proposed Government hydro-electric developments in New Zealand. We understand that the Dominion Parliament has now sanctioned the expenditure of £300,000 on the three most favoured undertakings, although it is considered that only one scheme will be proceeded with, viz., the Lake Coleridge one, to supply the City of Christchurch.

Meanwhile attention will probably be given to the Hutt scheme for supplying Wellington, a more complete investigation of which is desired. Two reports were recently submitted to the New Zealand Public Works Department, dealing with the power requirements of the Dominion, one by Mr. Birks, Government electrical engineer at Rotorua, and the other by Mr. Holmes, Engineer-in-Chief of the Public Works Department. From these it appears that the total power in use, exclusive of railways, in 1904, was estimated at 180,588 H.P., and in 1910 at 204,458 H.P., and that the four cities, Wellington, Auckland, Christchurch and Dunedin, would each give ample scope for the supply of 10,000 H.P. or more of cheap electric power, judging by their present power requirements. The tramways in these four centres are credited with consuming about 15½ million units per annum now, and 18½ millions in 1915, while the electrification of certain railways, such as the Lyttelton-Christchurch and Arthur's Pass tunnels, and the suburban lines, particularly the Wellington-Hutt and the Auckland-Penrose sections, is held out as a further inducement for power development.

The value or otherwise of a report of this kind is, of course, more readily appreciated by the man on the spot than by others, and in this connection another report by Mr. Stuart Richardson, the Wellington city electrical engineer, which is based on statements contained in the above reports as affecting Wellington particularly, and which was submitted to the House of Representatives in debate, is of considerable interest.

Briefly, whereas Mr. Birks estimated Wellington's requirements in 1915 at 27½ million units per annum, at an average cost to the city of ·81d. per unit, the city engineer believes 12½ million units to be nearer the mark, and, moreover, he deduces from the rates suggested, that the city would lose some £24,000 per annum.

Mr. Richardson, however, prepared a further schedule of prices at which the city could afford to purchase Government power and make a profit of £4,000 a year, an amount which is anticipated in the present year, and on this basis the Government would receive ·66d. per unit, a figure which nearly corresponds with the estimate of Mr. Holmes, viz., about ·6d., and which represents about £34,000 of the £38,000 estimated annual charge in the case of the Hutt scheme for supplying the city and other localities.

It is, of course, as yet uncertain whether the Government can supply at ·66d. per unit and at the same time give such a guarantee of continuity of supply as will enable the Wellington authorities to shut down entirely their steam plant, but no doubt, on the figures, it is fully justified in looking closely into the merits of the Hutt scheme.

The Government control of the national water powers has been criticised locally, although, of course, it is by no means peculiar to New Zealand; although it no doubt tends to retard hydro-electric development, it also effectively prevents speculation in concessions, an evil which has recently induced the Japanese Government to take over the control of the water-power of that Empire.

Liabilities of Cable Companies.

It is not often that questions arise in English Courts with regard to telegraphic codes. For some reason, vital mistakes in coded telegrams do not seem to occur very often; and even if they do occur, it must be presumed that the circumstances are such that no action can be brought in respect of them. A case which was heard in the King's Bench Division last week draws attention to the rule that a code must contain pronounceable words. In the case in question an action was brought by the owner of a telegraphic code, known as the "Five-Letter Code," against Reuter's Agency for libel alleged to be contained in a circular. In the circular the defendants had drawn attention to the fact that code words must consist of words capable of being pronounced according to the current usage of German, English, Spanish, &c. The circular then went on to say that "a made-up pronounceable word such as Maturatumo will be passed on all lines, whilst a combination such as Y Q Z U Z Y Q Y X O would be taxed, and if transmitted, charged at cipher rates, viz., five letters to a word." The plaintiff alleged that this word was a combination of two words taken from his code, and that the publication of the statement was calculated to injure him in his business.

It came out in the course of the case that the word in question was in the plaintiff's code, and that it was copied from a telegram written in according to the code; but the defendants did not know this when they took it "as a sample." It was also proved that the English telegraph authorities would accept the word, but they would not guarantee that other authorities would accept it. The jury found that the language used might be defamatory of some codes; that it would not be understood by reasonable people as referring to the plaintiff's code; and that there was no malice and no damage. Consequently, the defendants had judgment.

While a code word should be distinctive, it ought also to be pronounceable; and if any question were to arise as to the liability of a cable company for delay or mistake in transmission, the fact that the code words were unintelligible might be taken into consideration. There is no implied contract that a telegraph company are to be liable for mistakes. In an old case a special Act gave a telegraph company powers for laying down their line, and enacted that the use of their telegraph and apparatus for the purpose of receiving and conveying messages should, subject to the prior right of use for the service of the Crown, and subject to such charges and reasonable regulations as might be made by the company, be open for the sending and receiving of messages by all persons alike. The company stipulated that they would not be responsible for mistakes or delays in the transmission of, nor for the non-delivery of, unrepeated messages from whatever cause arising, and that half the usual price for transmission would be charged in addition for repeated messages.

It was held that the obligation of the company to use due care and skill in the transmission of a message arose entirely out of contract, and that the vendor of goods who received an offer by telegraph from the vendee could not maintain an action against the company for a mistake in the message. (Playford *v.* United Kingdom Electric Telegram Co., 4 L.R.Q.B., 706.)

In a later case, it was held that no action will lie against a telegraph company at the suit of a receiver for misdelivery of a telegram, unless there is either a contract between him and the company, or (possibly) fraud on their part in the transmission of it. (Dickson *v.* Reuter's Telegram Co., 2 C.P.D., 62.)

While on this point, it may be mentioned that in another case it was held that there is nothing confidential in a cipher. Thus, in one case, a telegram company in London made an arrangement with the defendants (being two individuals in Australia) for the transmission of messages, in which certain words were used as short expressions of the names and addresses of the principal customers; and the defendants were described as agents of the telegram company. In a little time the parties quarrelled, and one of the defendants came to England to carry on an independent telegram business with his partner in Australia, and sent circulars to the customers of the telegram company mentioning that he had their ciphers. On motion to restrain him from using the ciphers it was held that there was nothing confidential in the ciphers and that he was entitled to use them. (Reuter's Telegram Co. *v.* Byron, 43 L.J.Ch., 661.)

A MERCURY VAPOUR RECTIFIER FOR LARGE POWERS.

Hitherto it has been found impossible, owing to practical difficulties, to construct the Cooper-Hewitt mercury vapour rectifier for outputs greater than about 30 or 40 amperes. The chief difficulties met with are (1) the mechanical weakness of the large glass vessels hitherto used; (2) trouble in arranging the leading-in wires through the glass for heavy currents; (3) gradual fall in the vacuum, which necessitates replacement of the apparatus after a certain time: and (4) difficulty in ensuring sufficient electrode surface for heavy currents.

Experiments recently carried out at Messrs. Hartmann and Braun's works by Herr Béla Schäfer, have led to the development of an improved rectifier, capable of dealing with 300 amperes or more, and this will shortly be placed on

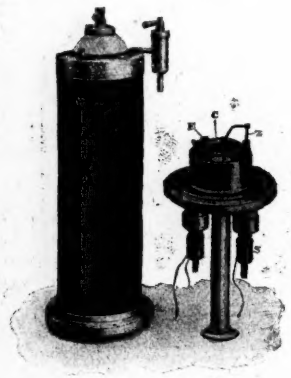

Fig. 1.

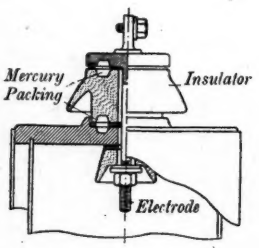

Fig. 2.

the market. This rectifier consists, as shown in fig. 1, of a thin steel tube some 7 in. in diameter, closed at the top and bottom by plates of solid metal. Vacuum tight joints are secured by the use of asbestos and mercury, and have proved very reliable in practice. The insulated anode is carried through the upper plate, as shown in fig. 2, whilst the mercury cathode (together with two auxiliary anodes) is carried by the bottom flange, as shown to the right of fig. 1. An outer sheet-iron tube surrounds the steel tube, and cooling water is allowed to circulate between the two. With the large area of mercury surface necessitated

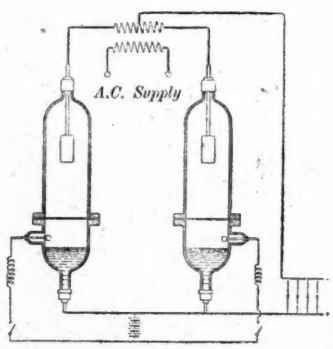

Fig. 3.

by the heavy currents, considerable wandering of the arc is possible, and this introduces voltage fluctuations. This action is prevented by surrounding a central portion of the mercury surface by a small fireproof tube c (fig. 1). The arc is struck within this tube and continues to pass from this comparatively small area to the anode. The movable striking anode *z* is controlled by means of the solenoid *s* outside the chamber. The second auxiliary anode *e* is arranged to keep a small exciting arc of a few amperes constantly burning. This separation of the cathode excitation from the main arc has the advantage of keeping the rectifier in an active condition, even when the main current is reduced to zero—the ordinary rectifier, on the other hand, does not permit of the reduction of the main current below a certain minimum. The action of this new rectifier is as follows:—The auxiliary striking anode *z* first dips into the mercury within the tube *c* momentarily, and the auxiliary arc from *e* starts and is immediately followed by the main arc. At the same time the starting of the auxiliary arc automatically disconnects the striking anode *z*.

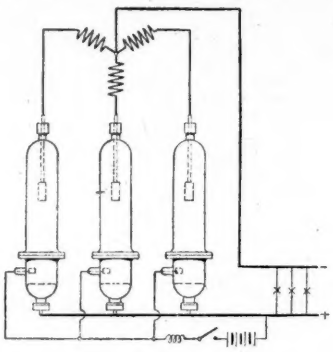

Fig. 4.

The above described arrangement, so long as the exciting arc is alight, will serve as a rectifier, inasmuch as it allows the current wave from anode to cathode to pass freely whilst entirely cutting off the half wave of the alternating current which tends to pass through in the opposite direction. In order to make both half waves available in the direct-current circuit, a second exactly similar rectifier chamber is necessary, connected as in fig. 3. For three-phase circuits three separate chambers are used, connected as in fig. 4. In these diagrams the exciting arc is shown supplied from a small battery, this is not essential, for alternate current can be employed, as in the case of certain A.C. mercury vapour lamps, provided that a second auxiliary anode is introduced into each chamber.

The use of separate chambers for the separate phases simplifies the construction, whilst at the same time preventing all chance of accidental short circuits between the main anodes, such as have often given trouble in the case of the existing glass single-chamber mercury vapour rectifiers.

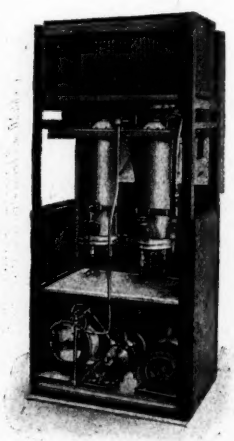

Fig. 5.

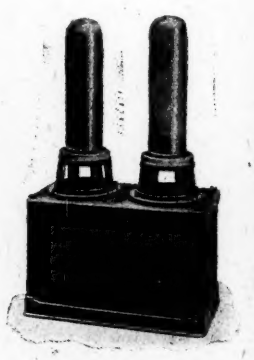

Fig. 6.

Although, as stated above, the joints employed are entirely air tight, and no leakage occurs, it has been found impossible to extract all the occluded gases from the walls of the chamber initially and, consequently, the vacuum is found to fall gradually. This trouble has also been found with the glass rectifiers, and in their case it has been usual to replace the entire glass vessel as soon as the vacuum had fallen too much. This is a costly process, especially in the case of the larger units, and also involves delay, so that in the case of these new rectifiers it has been judged advisable to supply a high vacuum rotary pump as part of each apparatus. At

intervals of about four weeks, this pump is run for about half a day, and thus serves to maintain a vacuum of about ·0001 mm. of mercury permanently, with the minimum of expense and trouble.

The whole apparatus with switchgear and pump complete, can be either mounted in a light frame as shown in fig. 5, or can be supplied in a totally enclosed form as shown in fig. 6. Fig. 5 shows a single-phase rectifier set for a direct-current output of 300 amperes at 240 volts, or nearly 75 KW. In this case each of the two compartments can carry 150 amperes continuously, but, with an additional supply of cooling water, each chamber could handle 250 amperes, giving a total output of 500 amperes. The cooling water in

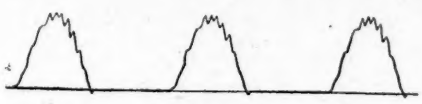

Fig. 7.

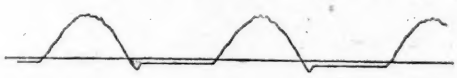

Fig. 8.

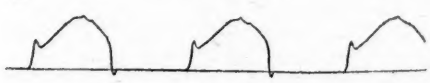

Fig. 9.

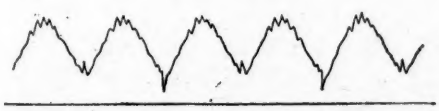

Fig. 10.

this form circulates from the vacuum chambers to the cooling chamber shown at the top of the frame, and thence back to the vacuum chambers.

Oscillographic curves show that each chamber cuts off the current in one direction entirely. Thus, fig. 7 shows the current wave for one chamber when the direct-current load is non-inductive and amounts to 140 amperes. The corresponding voltage curve (170 volts maximum value) is shown in fig. 8. When the direct-current load is made inductive, by the addition of a choking coil, the current of one chamber takes the form shown in fig. 9, whilst the curve of the total current on the D.C. side is shown in fig. 10. The pulsations

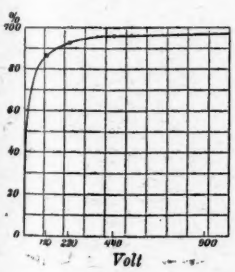

Fig. 11.

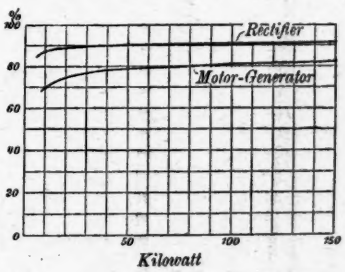

Fig. 12.

are still fairly considerable, but could be much reduced by the use of larger choking coils, and still more so if the A.C. supply were two or three-phase instead of single-phase. When the D.C. load consists of motors, the armature and magnet windings of these act as choking coils and smooth out the current waves.

The voltage on the D.C. side is remarkably constant between no load and full load, because the inherent drop of a mercury vapour rectifier, which amounts to about 15 volts, is practically independent of the current passing. Since the chief loss in these rectifiers is this 15-volt drop, the efficiency gets steadily higher as the working voltage is raised. Fig. 11 shows the efficiency as a function of the supply voltage, exclusive of the losses in the transformer, whilst fig. 12 shows the efficiences of various sizes of rectifier arranged for a D.C. supply at 220 volts, including all auxiliary losses in transformers, &c. For the sake of comparison a curve of the efficiency of two-machine motor-generators has been added.

Many possible uses suggest themselves for a rectifier such as this, which, for simplicity of operation and of mechanical construction, compares more closely with the ordinary alternate-current transformer than with the motor-generator or rotary converter. For instance, an electric railway can be imagined in which the line is supplied with a H.T. single-phase alternating current, and this is converted by means of a static transformer and a rectifier on the car to direct current and is used in standard direct-current motors.

Voltage regulation is simply effected by tappings on the supply transformers or by boosting transformers, &c., whilst the safety of operation is very great, as there is very little that is breakable about the apparatus and serious short-circuits are almost rendered impossible by the automatic increase of vapour pressure which occurs when the current increases greatly.—*E.T.Z.*

THE MAINTENANCE OF STEAM AND WATER PUMPS.

[COMMUNICATED.]

The questions relating to the proper design and construction of the various classes of pump machinery required for use in steam and water installations have received the extensive attention of the technical Press, but it does not seem that quite so much notice has been given to the various classes of work which have to be executed upon such plant, in order to maintain it in good and efficient working condition after it has once been installed. A pump is a piece of apparatus which, owing to the fact that in most cases it simply acts as an auxiliary to heavier machinery, is very liable to be treated with scant attention, and in many cases this results in a more or less total shut down, which might otherwise have been easily prevented. Even when this is not the case, however, the pump presents certain mechanical problems which are in themselves most interesting, and more especially so when these are considered in relation to the way in which repairs can be promptly and efficiently carried out by an ordinary fitting staff.

In order, first of all, to realise the kind of accident to which pumping plant is liable, it may be interesting to recite two or three typical examples of breakdowns, dealing more especially with their causes and indicating briefly the methods by which the pump was restored to normal working. An interesting example of this occurred in connection with a wet pump which, together with a separate air pump, was installed in connection with the withdrawal of air and water from an evaporative condenser. In this particular installation the suction pipe for the air pump came from the top of the condenser, while the pipe to the wet pump took the water from the bottom, this separation of water and air tending to increased economy in the auxiliary operations. The air pump had a special service of water for the purpose of sealing the valves, and there was, in addition, a separate service for the wet pump, whose purpose was the sealing of the valves until the water came down from the condenser. It was intended that this service should be shut off as soon as there was a sufficiency of water coming into the chamber of the wet pump to enable it to perform its duties properly, but on one occasion the man in charge of the plant omitted to turn off this water service after the wet pump was got under way, with the result that the extra water was too much for the pump to deal with, and as the water could not clear sufficiently quickly, the crank pin which drove the wet pump sheared off with the shock, and it was necessary to install a new pin before the wet pump could be got to work again.

In another case a steam plant was installed for the purpose of working non-condensing, and in order to supply the boilers with water, a combined vertical double-acting feed pump, without a fly-wheel, was installed to pump the make-up water from an overhead feed tank. At a later date, however, when the plant was extended, it was decided to

run this condensing, and the feed pipe was then altered in order to enable the boilers to feed from either the hot well or the make-up tank alone. This hot well was, however, below the level of the pump. At the first the vacuum obtained upon the steam plant was good, and the discharge from the air pump was consequently fairly cool. Owing, however, to continual accretion of work upon the steam plant, the engines became more and more fully loaded, until when full load was upon them the vacuum dropped to about 19 in. The increased heat of the water in the hot well, combined with the difference of level between the tank and the pump, made it impossible for the pump-chamber to fill up properly, and the pump began

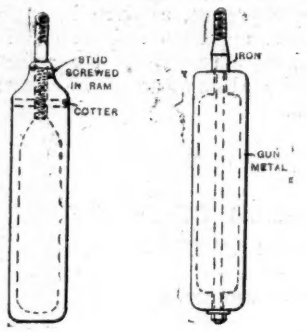

Fig. 1.

Fig. 2.

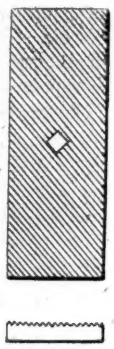

Fig. 3.

to knock badly. Ultimately, the cast-iron brackets which carried the rods working the valve gear of the pump snapped across, and until this bracket could be repaired with pieces of angle iron, the pump was put out of commission. In order to effect a permanent cure for this trouble, a small three-throw pump was installed in order to lift the water from the hot well to the former feed tank, and the feed pump was only used on the latter. In this way the trouble of knocking on the pump disappeared, although, owing to extensions of plant, it was more fully loaded than was formerly the case.

In another power plant installation, a three-throw electrically-driven pump was used in order to feed the boilers through an economiser, which preheated the feed. On this economiser there were relief valves, but these did not prevent the breakage of the barrel of the feed pump, owing to the check valve of the boiler on which the pump was working being shut. The relief valves operated quite satisfactorily, but apparently the knock upon the barrel was too sudden. As the pump was urgently required, a temporary repair was made by means of putting two clamps completely round the three barrels of the pump, and cementing with red lead and putting the pump upon light duty; that is to say, not subjecting it to the full head of the boiler, but using it to pump water to a feed tank, and under these conditions it worked fairly satisfactorily until a new casting was obtained.

In another case the vacuum of a complete power plant, which exhausted into a main condenser, fell suddenly without warning from 26 in. to 10 in., owing to what was originally a very slight trouble. The condenser was exhausted by means of a separate air pump and wet pump, the latter being driven from the air pump shaft. The trouble occurred owing to the fact that one of the mushroom valves on the delivery side of the wet pump stripped the thread on the stud which held it in its place. In this way the valve failed to close, and allowed the air pump to draw back from the discharge pipe. As the result of investigation, it was found that the probable cause of the stripping of the thread was that the nut was a trifle loose on the stud in the original case, which gave a certain amount of play, ultimately resulting in knocking and stripping.

Two other typical instances of pump breakdowns may be placed on record due to what may be termed the auxiliaries of a pump. The first relates to the pipe work connections to which the pump is coupled, and to the means used for effecting this purpose. An air pump which was coupled direct to a high-speed steam engine, was provided in the discharge with a two-way cock, to enable the water from the air pump to be sent through the hot well, or if for any reason it was required to keep this hot well dry, direct into the drains. During the course of erection a mistake was made in the coupling up of this cock, the body of the cock having been put in the wrong position relatively to the pipe work. When the engine was on its preliminary trials, it was first of all run non-condensing, and in this condition answered requirements. Afterwards the condenser was used, and the condensed water from the air pump discharge was at first run to waste; up till this point everything seemed satisfactory. It was then decided to discharge the water into the hot well tank, and the cock was turned apparently to this position. Owing, however, to the wrong placing of the valve body, the turning of the cock resulted in stopping any exit for the pump discharge, with the result that a sudden shock was placed on the pump and practically exploded the pump body, parts of the casting flying to a considerable distance. This, of course, involved the construction of an entirely new pump. In the other case may be instanced an air pump which was in this instance driven by means of gearing. It had been somewhat heavily worked, as there was no spare plant available, and frequently ran for 160 hours per week. The result of this was that the pinion of the gearing, which was constructed of raw hide, was very badly worn and the shrouding teeth at the sides were considerably in front of the bearing faces of the teeth. Owing to continued running and the difficulty of maintaining an effective supervision, the key on the pinion shaft gradually worked loose and allowed the pinion to shift along the length of the shaft. This caused the brass teeth of the shrouding to catch the larger gear wheel, with the result that it was considerably broken up.

Turning now from the consideration of some of the causes which lead to unsuspected failures of air and water pumps, it may be interesting to briefly relate one or two practical methods by means of which pump parts have been repaired in a more or less temporary manner, either so as to enable them to run quite satisfactorily, or, where this has not been accomplished, sufficiently well to tide over the period of exceptionally heavy duty, preventing a complete stop for the purpose of a permanent repair.

A useful example is that of a ram pump repair which became necessary owing to the stripping of the screw threads in the hole where the screw stud was fixed into the ram, as shown in the first illustration. This ram was made of common open-grain cast-iron, and the metal immediately surrounding the screw became rotten through saturation with impure water, with the result that the screw stud was pulled completely out. In order to repair this ram, which was required for fairly constant duty, the part of the stud which screwed into the ram was "jumped up" while it was hot, thus increasing its diameter. The stud was then screwed a size larger, and the hole in the ram was tapped out in order to suit this next size. It then only remained to screw the stud into the ram and couple it up to the pump crosshead. This in itself was quite an effective repair, but in order to make the matter more certain, having regard to the impure nature of the water which was being pumped, it was decided, when the pump was available for a longer stop, to cut a cotter-way through the centre of the ram at the top and also through the stud at the portion where it was screwed into the ram. A cotter was then put in, and this was kept from subsequently working out by bevelling the edges of the cotter holes on the outside of the ram and pinching the cotter over to fill the bevelling. After the projecting portions of the cotter had been filled up flush to the surface of the outside of the ram, a very useful and permanent repair was effected, which, in reality, was an improvement on the original design.

Somewhat analogous to this is a repair which took place at a time when there was very little in the nature of spare material available for repair. A feed-pump ram stripped its thread in the same way as before, and the stud in consequence came out. The repair was effected by means of cutting down the shank of a fire tool or slice to a length suitable to enable it to go right through the ram and to leave a sufficient length of its outer end to form a stud, and take a nut and washer at the bottom and outside portion of the ram (fig. 2). In order to make the neck and tapered portion of the rod which fits into the bottom portion of the

crosshead, an iron bar was jumped up at this part and then filed down in order to suit the conditions, and in order to allow the iron bar to pass through the bottom of the ram pump a hole was drilled at this place and tapped. After the ends of the bar had been screwed to suit this tap hole, and also the portion of the bar which goes into the pump crosshead had been given a screw thread, the repaired ram was ready for assembling. This formed a very excellent repair, and the ram ran in this condition for some years after the accident. Such a repair would, of course, only be possible where it had been ascertained that there was sufficient clearance between the end of the ram and the pump cylinder bottom to allow of the introduction of a nut and washer, as shown. The probable reason for the stripping in this case, was that as the pump was working in impure water, galvanic action was set up between the steel of the rod and the gun metal of the ram itself, rotting the gun metal at the portion where the two metals were in close contact, that is to say, at the threads on the ram.

Another interesting case shows the way in which a fracture on a donkey pump crosshead was repaired in an emergency. Fig. 4 shows a fracture which occurred owing to the fact that the bolt marked A snapped when the pump was running, possibly owing to the fact that the nut was too tight. The repair was effected as shown in fig. 5 by fastening a piece of ½ in. steel plate across the full length of the crosshead. This was done by screwing rivets into the casting, which rivets were sunk into counter-sunk holes in the plate. There were six holes drilled into the plates, in order to allow the coupling bolts to pass through, and the top brass and distance pieces were then reduced in depth by ½ in., in order to keep the same overall length of motion. The fractured portion of the top casting was then

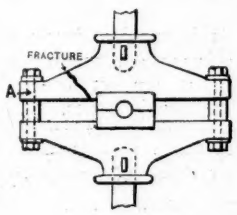

Fig. 4.

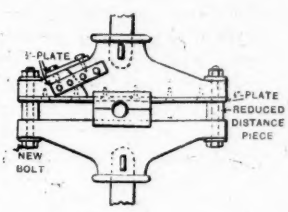

Fig. 5.

further secured by means of a piece of ½-in. plate secured by ¾-in. bolts, which were screwed through holes drilled in the plate and into tapping holes in the crosshead. Two other smaller pieces were fastened in the same manner on either side on the top half of the crosshead, the sketch illustrating the position of these repair pieces. This was not considered to be a permanent repair; but, nevertheless, it enabled the pump to be used in removing approximately 3,000 tons of water before a suitable opportunity occurred to renew the crosshead.

In some types of pumps the bucket rings are made of ebonite, or some similar composition, and it is found, especially when pumping warm water, that these very speedily loose their spring and allow water to let-by. When this is the case and the pump is taken apart for examination, it is found that the ring is very little worn and practically equal to new, but that the rings have closed in, butt to butt. When this occurs the rings can be stretched very easily without injuring them, and cut and fitted to the chamber by a very simple practical method. The ring should be taken hold of by means of two pairs of tongs and plunged into boiling water. They should be allowed to remain in the water for a few minutes, and each ring should be pulled by means of the tongs to stretch it out slightly when in the hot water. It should then immediately be plunged into cold water and allowed to lie for a time. It will be found that by this means a new permanent set has been given to them which will enable the engineer to make them a good fit in the pump chamber again, without resorting to the expense of new rings.

Another trouble which sometimes afflicts pumps of this description is that the group valve seats become worn oval instead of remaining flat. This causes the pump to draw badly, and it becomes necessary, in order to maintain operations, to knife them flat again. In cases were it is impossible to secure all the usual appliances, it may be interesting to bear in mind a method of making a suitable knife. This can be done by taking a piece of chisel steel and drawing it out to the approximate dimensions of, say, 4 in. × 2 in. × ½ in. It can then be finished with a square hole at its centre, as shown in fig. 3, and teeth cut into it in the same manner as is found on a milling cutter. If this tool is then fixed up on a ratchet brace and drill stand attached to the pump, the valve seats can be knifed down without removing them from their places. It is advisable to put the old valves into the lathe and face them up at the same time.

Yet one further practical hint may be given in regard to the treatment of pumps. It occasionally happens both in air and water pumps that it is a difficult job to get a length of rope of the right diameter to pack the bucket, and as some engineers like to have the bucket so tight that it has to be hammered down, it very often happens that the outside of the rope has either to be hammered with a mallet or burnt with a hot iron, in order to reduce the over-all dimensions of the packing. Either of these methods tends to damage the rope and shorten the time during which the pump packing will remain in efficient service, and a better method is to take a rope of smaller diameter and previously to fitting this into the barrel, to put one or two turns of canvas round the barrel, in order to build up the over-all diameter to exactly the required size. It will be found that this gives a perfectly air and watertight packing.

The above notes are by no means a scientific contribution to the subject of pump design and construction, but it is suggested that they may be of interest to engineers who, having ordered and received their pumps, are anxious to maintain them in a good working condition, and should they be afflicted with a breakdown, to know what to do in order to effect the necessary repair with the least possible loss of time. It is, of course, quite out of the question to describe the entire range of accidents which may possibly occur to a pump in practice, but it is hoped that the above examples may furnish sufficient material to form a basis for action in the case of the more usual classes of breakdown of this description.

WHAT'S WRONG WITH THE COLLEGES?

THE LACK OF DISCIPLINE.

(BY A UNIVERSITY LECTURER.)

The term "slacker" may not be pretty, but it admirably expresses a type. "Waster"—a word borrowed from the foundry—means something different. The "waster" is a vicious "slacker," and when a man or student is labelled by his fellows as one with a full knowledge of vice, we cease to be interested; we become wary of him. The "slacker" is a brand that may be snatched from the burning; it is possibly only the opportunity which makes him a "slacker." And among the best places for a youth to find splendid opportunities to practice the art of slacking is the average university or technical college. That's the weak spot in our present system; there is no discipline, or very little of it, in the training of technical students.

There is an amusing story current in such circles concerning Prof. Kapp and his efforts on behalf of the engineers-in-the-making at Birmingham. It will serve as an illustration, although it may possibly be denied. It happened that the day's work at the local seat of learning commenced at 10 a.m. and—after various intervals for lunch, dinner, &c.—ended, theoretically, at 5 p.m.; in practice, soon after 4.30 p.m. Moreover, even the time-table programme of 10 to 5 made the day too short for certain important instruction. So the practical professor announced that he would commence at 9 a.m. (the story says 8 a.m., but that would be impossible in a college—the very porters would strike). On the first morning there was no attendance, and thinking a mistake had been made, a further announcement was issued;

but the result was approximately as before. And it is said that the 10 o'clock routine still obtains!

Another lecturer once remarked to the writer, "It is of no use arranging a lecture before 10.30 a.m., because the men never turn up." The stories give some idea of the prevailing notions concerning the time at which the day's work should commence.

What is the effect on the student? He has full facilities for slacking at college, and when he gets into his first job he is quite annoyed if requested to arrive at 9 a.m. or to work overtime. Of course, there are exceptional men who are not affected by the insidious examples, but it ought to be quite impossible for a student to develop irregular habits of attendance. No wonder that the works manager is frequently annoyed with the college graduate. The latter usually does not understand anything of life's hardest lesson —how to obey orders. In this respect the boy trained in the works contrasts favourably with him. The college man can usually beat the ultra "practical" man (it often means the ultra "ignorant" man) on a variety of points—general intelligence, technical knowledge and initiative—but all of these things weigh not in the scales against the defect summed up in the phrases, "he lacks an acquaintance with discipline," or, "he won't knuckle under." The immediate ray of hope is the movement for officers' training corps, which supplies a little training in teaching the students *to obey*.

Defects of Oxford and Cambridge.

The newer centres of higher education suffer from the pernicious example of those ancient seats of learning by the Isis and the Cam. It is true that under the inspiring leadership of Sir J. J. Thomson (the man was once hoping to become an engineer, and fought his own battle of life) the scientific spirit is slowly stirring Cambridge. Oxford seems almost hopeless, despite Lord Curzon and the Rhodes scholars. Of course, it doesn't matter much about the men who are training for the church, politics or the bar—they are always, more or less, masters of their own time. It is an altogether different problem in industrial life. A large firm were written to concerning an employé the other day, and their reply was: "In answer to your inquiries of Mr. Brown, we are pleased to be able to say that we found him a good time-keeper." Anything further in Mr. Brown's favour was superfluous.

The trouble of it is, that the people who control education of all sorts in this country are saturated with the ideals of Oxford and Cambridge. This is no crude attempt to abuse those places—one must respect them, despite the frequent and irritating evidence of senility which they furnish. A diplomatist or civil servant will always praise the older Universities—he knows of the useful friends he made there; many of the colleges have rich livings and other patronages to bestow. These things are possibly an advantage to the man who wants to "get on" in other spheres than engineering. The type of student common to technical colleges is the one who must work for his living. We give him an excellent opportunity to learn the calculus or to use the oscillograph, but allow him to fall into very bad habits with respect to punctuality and discipline. It is no excuse to say that we only pretend to teach technics; we cannot expect the average youth of 17 to 20 to do anything but take the line of least resistance; in colleges that means doing just about enough to pass examinations.

As already explained, the principals and many of the staff of the new universities are saturated with the leisurely notions of Oxford and Cambridge. When the lecturer, worried with a conscience, thinks and speaks of the parents or the lad's future, he is met with the answer, "This is not a school, we cannot compel attendance." But the State and the local rates are subsidising the places, the student's education is being paid for, not only by his parents, but by his fellows. Surely it is his duty to them to get good value. When a man receives a subsidy from the community and wastes it, he becomes a parasite.

The writer is not at all certain that the vacations are a blessing to the student. Undoubtedly the staff of the colleges require long vacations if they are to undertake research work; but nine or ten weeks of holiday is too long for the college youth. That is the great advantage of the Sandwich system—it keeps the lads busy in the vacation, and they obtain a taste of the discipline of the works.

A way out of the difficulty is the addition to the governing bodies of technical institutions of business engineers. It is no use for manufacturers to talk rapturously or vaguely to praise technical education. They must take an active part in the work. When the story comes to be written, it is probable that a new generation will recognise that Sir W. H. White has done more for technical education in this country during the last few years than almost anyone. Some people say he is a martinet, because he likes discipline. The people who say that usually abhor obeying orders. Their training was such that they honestly think that colleges could not be improved. Surely it is up against the manufacturers who know of this great defect in engineers arising from a college course to insist that all students should be at least good timekeepers. Discipline is a difficult, but it is an essential, part of a youth's training.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Limerick's Engineer.

"Fairplay" apparently wishes to bring the eternal religious question into this "job." What more natural than that the man appointed should be of the same religion as the vast majority of the Council? Surely no one would accuse an English or Scotch Council of bigotry when a non-Catholic receives an appointment on its staff.

With these small municipalities it is usually simply a question of the man with the most influence; qualifications are a secondary consideration. There are, of course, exceptions, when none of the candidates have influence.

Limerick adopted the silly Irish custom of settling the business in public instead of in Committee, otherwise everything would have been quite as usual. We do it "cuter" on the East Coast, where we are more Anglicised. In the North they are quite "canny" over such appointments.

Irishman.

Regarding correspondence on this matter, candidates for Civil Service appointments are required to have a knowledge of English history and literature, and sometimes another language is added, neither of any practical value for the work to be performed after appointment. This may be wise or otherwise, but will your correspondent "Fairplay" refuse the same rights to the Limerick Corporation, and if so, why?

Such appointments may be considered public or quasi-public, and it may not be unreasonable to think that a knowledge of Irish history, customs, &c., would not be too much to expect from a well-educated man such as an electrical engineer is supposed to be, and also that it would be no hindrance in the performance of his duties. A knowledge of the Irish language has been asked for in commercial appointments in the south and west of Ireland, and Gaelic in the highlands of Scotland, for years past.

As to the last paragraph in "Fairplay's" letter, where he states that "such happenings are of daily occurrence," surely he does not mean to convey that borough electrical engineers are appointed daily in Ireland. Then he gets mixed up in a delightful tangle of "Home Rule," "Electrical Engineers," and English manufacture. The prophet's mantle is evidently not an easy-fitting garment.

I intervene principally to refute his base and calumnious statements that religion plays an important or any part in public appointments in the South and West of Ireland. A return giving details of public appointments in every county in Ireland was moved for, and read out in the House of Commons by the Chief Secretary for Ireland last session, and it showed that on a basis of population Protestants in the

South and West of Ireland got three or four times their share of well-paid public appointments, whilst in the North, where there is a Protestant majority in some few counties, no Catholic need apply. This return was published in all the leading journals, and your correspondent ought not be ignorant of it.

Wm. H. Murphy.

Glasgow.

A Two-Phase Complication.

In your issue of January 27th an article appears under the heading, "A Two-phase Complication," in which a case is discussed, where, owing to a wrong connection of a two-phase motor to the mains, the wattmeters gave somewhat irregular readings.

Owing to the misconnection, it was found that one meter gave a positive reading of 2,400 units, and the other a negative reading of 600 units during one month, and your correspondent concludes that the supply company would be justified in a case of this kind in charging the consumer with twice the amount registered on the meter giving the positive reading. This conclusion is not correct, as may be explained in the following manner.

It will be noted from the diagram that the meters are connected so as to measure the energy supplied by each phase of the system. This being the case, the sum of the readings of the meters, *with their proper signs*, must give the total energy supplied to the consumer under all circumstances, and in this particular instance the total number of units that should be charged for would be 2,400 − 600 = 1,800 units, which will be seen to agree fairly well with the 2,000 units per month registered before the misconnection of the motor was made.

The result of connecting up the motor in the manner indicated was to cause both the meters to carry the same current, but this common current would not be represented by the vector O C in fig. 2, but should be represented by a vector approximately at right angles to this direction.

If this change be made in the diagram, it will be seen that the power will be positive in one phase and negative in the other, and this accounts for one meter running backwards.

The induction motor was acting as a connecting link between the two phases of the generating station, and was transferring a proportion of the energy taken by phase A to phase B, the remainder of the energy taken by phase A being applied to do mechanical work in the motor.

In this manner energy was being pumped back to the station through phase B, and the total energy taken by the consumer was the difference of the energy taken by phase A and pumped back through phase B.

It may be pointed out that it is by no means uncommon to find pumping back of this kind taking place in two-phase motors even when they are correctly connected, and the writer has seen frequent examples of this, particularly in the case of two-phase motors running light.

This effect is due to slight displacement from exact quadrature in space of the two phases of the windings of the machine.

The loads on the two phases will generally be found to become more and more equal as load is put on the motor.

A. J. Makower.

London, S.W., *February 6th*, 1911.

Referring to the article "A Two-Phase Complication" in the number for January 27th, our friend seems to be on the wrong tack. Fig. 1 simply shows the windings X and Y to be in series with one another across the two phases (*i.e.*, across 283 volts) with a somewhat erratic earth current in parallel with Y. This "earth" does not complicate the matter as suggested; but seems to me to help the motor to start, and then disappear or diminish to a very small quantity. If reading the meters, I should take them as correct and charge for 1,800 units as registered, for the following reasons:—

Since the motor has been running and on load, it must have been running as a single-phase motor, the flux taking up a position between the two windings; and these windings being in series, their fluxes will be in phase with one another and form the resultant flux as stated. Fig. 3 represents the running conditions: O B is phase B voltage, and O A that of phase A, O Z is the resultant of O B and O A, *i.e.*, $\sqrt{2} \times 200$.

O C represents the current. The units registered by meter *a* will be O C cos θ O A, which can be seen to be a large quantity; and by meter *b* O C cos $(45 + \phi)$ O B. Meter *b* will, however, run backwards, for under normal conditions the current and voltage in phase B would only have a small difference in phase, but now owing to the connections of the motor being altered O C has been reversed through meter *b*, but not through meter *a*. See diagram of connections.

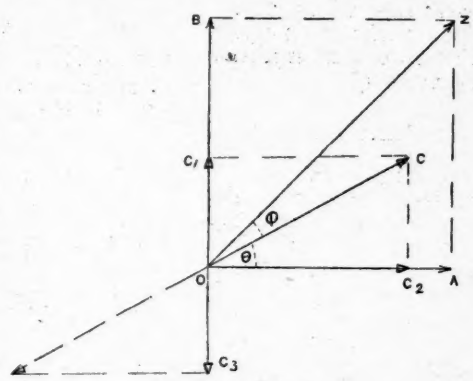

Fig. 3.

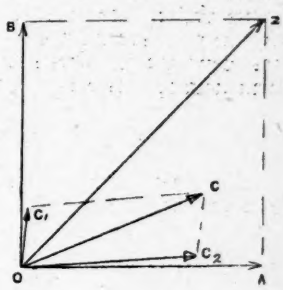

Fig. 4.

Therefore, O C_3 × O B represents the watts registered by meter *b*, which can be seen to be a small quantity compared with O C_2 × O A.

Considering the conditions at starting, in fig. 4 C is the current in X, then the current in Y is something less and slightly different in phase, as C is the resultant of C_1 and C_2, C_1 being the current in the faults to earth and C_2 the current in Y. Thus C and C_2 will tend to turn the rotor in the same direction as two currents, one lagging behind O B and the other lagging about the same angle behind O A, but the motor will only start slowly, as the difference in phase between O C and O C_2 is small. When the motor attains full speed the earth currents disappear or become very small; if they developed into a dead earth, there would be a short across Y, and the protective gear would operate; the full voltage (283 volts) would be applied to X, and about 280 volts would be generated in Y, the short would be on this. The voltage across the outers on our friend's system would simply be $\frac{\sqrt{2} \times 200}{2} = 141$ volts, which would account for his 200-volt lamp glowing dull red. Did he also try the lamp across the inners? I think that when the motor was running at full speed he would have found it glow in the same manner there also.

Henry Denham.

Ulverston, *February 5th*, 1911.

Electricity in Mines.

I do not agree with your correspondent, "Mining Electrician," that should the Home Office insist that charge electricians of mines must hold a certificate of competency, their present salaries should be increased.

The salaries already paid for mining charge-electricians are up to the standard, and it amply meets the requirements. The important question is to have competent men in responsible positions and not for the sole purpose of demanding high salaries.

The mine manager gives the appointments to charge-electricians, and no doubt will continue to do so, even should the Home Office appoint a Board of Examiners.

"Mining Electrician" does not see any necessity for motormen to hold certificates. My chief reasons are too obvious for detailing here, and it seems to me that his knowledge of mining is rather vague.

Celt.

We have received a letter from "Consultant," Manchester, without the name of the sender; it is therefore held over pending the receipt of the latter.

THE ALLOCATION OF EXPENDITURE OF ELECTRIC LIGHTING AND POWER SUPPLY UNDERTAKINGS.

The necessity for, and importance of, correct allocation of the expenditure of electric lighting and power supply companies, as between capital and revenue, are at once obvious and unquestionable. The usual result of incorrect appropriations may be expressed as inflation of profits. In the case of electric lighting concerns, as, indeed, in the case also of electric tramway undertakings, the general custom is for the chief engineer, or some other responsible person, to supervise the necessary allocated statements of wages, salaries and stores, and to certify their correctness to the management of the company.

These statements, so far as they relate to revenue, indicate the periodical expenditure under the following headings:—

Generation.—Fuel, including carriage or freight thereon, oil, waste, water and engine room stores, salaries of engineers, proportion as certified by engineer, and wages at generating stations.

Repairs and Maintenance.—(1) Buildings; (2) engines and boilers; (3) dynamos, exciters, transformers, &c.; (4) other machinery, instruments and tools; (5) accumulators and accessories.

Distribution.—Salaries of superintendents and officers as certified; wages of linesmen, fitters, labourers, &c.; repairs, maintenance, and renewals of mains; repairs, maintenance, and renewals of transformers, meters, &c.; repairs, maintenance, and renewals of apparatus at distributing stations.

Public Lamps.—Attending and repairs; renewals; royalties on use of patents; rents; rates and taxes.

Management Expenses.—Directors' remuneration; salaries of managing engineers, secretary, &c.; salaries or commissions of collectors; stationery and printing; general establishment charges; auditors of company; auditors of Board of Trade; law charges; insurance, &c.; which follow as nearly as may be the itemised titles of the accounts as they appear in the Board of Trade form of accounts, are accepted by the office, and they are journalised and posted to the respective accounts in the ordinary way. They are also accepted by the auditors on behalf of the shareholders of the company as well as by the auditors on behalf of the Board of Trade representing the interests of the local authority. Moreover, they are not in many cases subjected to much scrutiny or criticism, which points to the necessity for their being thoroughly checked and reviewed in detail both by the office and by the auditors.

The allocated wages and salaries, particularly the former, are prepared from the time sheets, the latter being frequently the result of the general survey of the work done during the period, and are therefore of a more or less approximate nature. There is, however, no neglect in seeing that capital is charged up to the hilt. The routine pursued in relation to the stores varies. In some instances the invoices themselves are directly allocated to the work concerned; in others they are allocated to "stores," and the issues therefrom charged to the accounts concerned, according to the appropriations indicated in the requisitions where these are in use. There is in many instances but little check exercised upon the station allocations, and the frequent meagreness of the details supplied, if any, in relation to capital expenditure, affords little or no material assistance to an independent person who is endeavouring to ascertain whether any of the charges, either wholly or partially, are really capital or whether they are really revenue.

Recognising that the Board of Trade is supposed to watch over the interests of the local authority, we may notice briefly an important factor, namely, distinction in the treatment of the appropriations of the expenditure of electric lighting and power companies. Now that which may be correctly interpreted as capital expenditure, and appropriated as such, in an ordinary industrial undertaking unfettered by a stereotyped form of accounts prescribed by law, is not necessarily capital expenditure within the meaning observed and imposed by the Board of Trade—that is to say, it is, in many cases, not such capital expenditure as the Board of Trade permit of being incorporated in the capital account section of its prescribed form of accounts, which are designed on what is known as the double accounts principle.

We are not referring to expenditure of a purely financial nature, but to expenditure which is fairly chargeable to the capital account of the operation and progress of the provisional order. The description of capital expenditure which the Board of Trade exclude from the capital account section of its form of accounts may, however, if it be confirmed as capital expenditure by its representatives, be shown in the general balance-sheet, one of the effects of which we shall presently notice.

There has been in the past, no doubt, too much "trafficking" in electric lighting provisional orders on the part of companies and their nominees, and some local authorities have entered into agreements with them, to the terms of which effect will have to be given if the former exercise their power of purchase, which means that the ratepayers will have "to pay."

Some of these agreements between the local authorities and the companies—particularly in urban districts—stipulate that the sum payable by the local authority, in the event of the exercise of its right to purchase, shall be the expenditure as shown by the capital account of the Board of Trade form of accounts to which we have referred, plus from 20 per cent. to 33⅓ per cent. of such capital expenditure sum. And if many of the local authorities were to set their rights in motion, what would they receive in exchange for such payment? The works, such as they may be, certainly. But in many cases a very second-rate and much depreciated, if not antiquated, asset—certainly not worth anything like the capital expenditure therein as disclosed by the Board of Trade form of capital account—and the goodwill, so to speak, would be much overvalued in many instances if from 20 to 33⅓ per cent. be exacted as the capitalisation of prospective profits. Some of these cases have been complicated since by the introduction of Parliamentary power supply companies, who have bought the stations from the companies working the orders, the latter being merely in possession of the distributing mains and other appurtenances essential only to distribution, the Parliamentary companies giving supplies in bulk to the distributing companies. Of course it is hardly necessary to state that usually such Parliamentary and distributing companies are in close union. It thus will be seen that there is every natural inducement for companies whose tenure may be comparatively short to heap up, as it were, the capital expenditure of the undertaking. The payment of dividends *(sic)* out of capital and not out of profits due partly, at any rate, to allocating revenue charges to capital is not unknown in the accounting of electric light and power supply undertakings.

Installation Contracts.—In our last issue under "Contracts Closed," "Government Contracts," we stated that the order had been placed with Messrs. G. E. Taylor & Co. for the electric lighting installation at Blackdown, *Jersey*. We understand that the work in question is for Blackdown Camp, Farnborough, *not* Jersey. Messrs. Taylor have in hand the electric lighting at Deepcut Camp, also in the Farnborough district; and they have just completed the electric lighting installation for Ewshott Camp, near Farnham.

LEGAL.

Borough Councils and Public Lighting.

In the Marylebone County Court on 2nd inst., the issue in a claim for damages to a motor-cab raised the question of the duty of Borough Councils in charge of the public lighting of the area under their control. The General Motor Cab Co., Ltd., sued the Paddington Borough Council for £41, being £31 18s. 6d. for the repair of a cab which had been damaged and 10s. a day for the loss of earnings during the period the vehicle was under repair. It was stated during the hearing that, in October last a taxi-cab driver in the employment of the plaintiff company, having picked up a fare at Oxford Circus, was proceeding along Bayswater Road, within the area of the defendant Council, and in trying to avoid a motor-'bus which had come to a standstill to unload passengers, drew out towards the centre of the road. He noticed another motor-carriage coming towards him on his off-side, and could not pass to the side of the road, so hugging the off-side of the 'bus, he ran on at 10 miles an hour. Scarcely had he rounded the 'bus, when he dashed into a street refuge—knocked down one guard-post, and "stomaching" the standard, which carried a gas lamp, buckled it, and it bent down on the top of his cab. There was no light in the lamp, and he contended that it was the duty of the Borough Council to light and to maintain such lamp lighted for public safety.

Evidence was given that the lamp was not alight at 10 p.m. on the 13th, and that one of the Council's employés, being apprised of the fact, attended to it and left it alight at 10.30 o'clock. Later passers by noticed that it had again collapsed and that it remained out till 6 a.m.

His Honour left it to the jury to say whether the Council, by their servants, had been guilty of negligence in allowing this lamp to remain unlighted. They were not bound to place these refuges in the public streets, but it was convenient that they should do so for the public safety. Having done so, however, they were also expected to light them, so that vehicular traffic might not be damaged by their presence on dark evenings.

The jury found that the Council had been negligent, and returned a verdict for the plaintiffs for the amount claimed. A counterclaim for damages to the post and standard was dismissed.

A further reference to this matter will be found in our "Notes."

An Undefended Claim.

In the Lord Mayor's Court on 2nd inst., before the Recorder (Sir Forrest Fulton, K.C.) and a jury, the Fuller Electrical and Manufacturing Co., Ltd., sued Mr. D. Jacobs, the lessee of the Paragon Theatre, Mile End, to recover the sum of £7 19s. 6d., the price of goods sold and work done to the order of the defendant. Mr. G. H. Higgins, barrister, appeared for the plaintiff company, but the defendant was neither present nor represented. Mr. J. L. Fuller, the manager of the company, said that acting on the instructions of the defendant a man was sent to the theatre last August to examine certain electrical fittings. Subsequently a starting switch was delivered at the theatre, at an agreed price of £4 5s. The defendant also asked the plaintiff company to inspect an armature, which was out of order. The armature was repaired at a cost of £2 4s. 6d., and a sum of 12s. 6d. was also charged for cartage. The prices charged by the plaintiff company were fair and reasonable. A letter was received from the defendant last September, in which he admitted agreeing to the price of the starting switch, but he knew nothing about the other items which were charged for. In addressing the jury, the Judge said that the defendant did not admit certain repairing work which had been done. However, the defendant did not appear to substantiate his case, and he would therefore direct that a judgment should be returned for the plaintiff company for the amount claimed. Judgment was entered accordingly for the company, with costs, and the Judge also certified for a fee for counsel.

The Reorganisation and Control Syndicate, Ltd., *v.* International Motor Traffic Syndicate, Ltd.

This action, which related to the right to eight electric motor-omnibuses, and involved complicated transactions between companies having the control of electrically-driven vehicles, was opened on Tuesday before Mr. Justice Neville in the Chancery Division of the High Court.

Mr. Jenkins, K.C., and Mr. Ward Coldridge appeared for the plaintiff, Mr. Gore Browne, K.C., and Mr. Austin Cartmell for the International Co., and Mr. Aston Cross for the second defendants, the Brighton, Hove and Preston United Omnibus Co., who had possession of the omnibuses in question.

In opening the case, Mr. Jenkins said that the plaintiffs were claiming the delivery up of the eight electro-omnibuses which were actually in the possession of the Brighton Co., and the question in the case really was whether the shareholders in the plaintiff company or the shareholders in the Brighton Co. were to lose by an arrangement come to between companies in which Dr. Lehwess was interested. It appeared from the records at Somerset House that the International Motor Traffic Syndicate was registered on September 10th, 1907, without articles, with seven signatories, and 100 shares of £1 each. Mr. Lehwess held 15 of the shares, Mrs. Lehwess 78, which, with the seven held by the signatories, accounted for the whole of the share capital. A company called the London Electrobus Co., Ltd., was registered on April 11th, 1906, and was formed for the purpose of running electric omnibuses in London. It was a very substantial company with capital of £70,000. It put a number of omnibuses on the streets, which omnibuses were supplied by another company in which Dr. Lehwess was also interested. In the year 1908 the Electrobus Co. issued £11,000 debenture stock, which was secured by a trust deed and was a charge upon the assets of the company. In the year 1909 the Electrobus Co. had got into difficulties; it could not pay its debenture interest and there was distress for rent in its Horseferry garage where there were some 20 omnibuses. On July 22nd, 1909, the trustees, under their powers given by the debenture trust deed, appointed a receiver and manager. On July 26th, 1909, the plaintiff syndicate was formed with a capital of £10,000 in £1 shares, to acquire interests in and manage other companies, and to carry on a general financial business. In that company 6,454 shares had been issued and paid for in cash, though counsel could not say whether or not they were fully paid.

His Lordship asked whether they were formed with the object of taking over the Electrobus Co.

Mr. Jenkins said not entirely, though no doubt that was the intention of the promoters. A meeting was held on January 3rd, 1910, of the debenture stockholders in the Electrobus Co., at which it was agreed to sell the undertaking and property of the company to the plaintiff syndicate for £3,000, of which £1,000 was to be paid in cash and £2,000 in fully paid up shares in the plaintiff syndicate. That sale was completed and an arrangement was then come to under which the £1,000 cash was to be found in the first instance by the defendant syndicate. On January 11th, 1910, there was an agreement between the two syndicates, under which the defendants were to have eight of the electric omnibuses to be selected by the plaintiffs, the vendors. The carrying out of that agreement was delayed by actions brought by two of the debenture-holders in the Electrobus Co. to set aside the sale to the plaintiffs, as being at an undervalue, but that action was dismissed. The eight omnibuses had never been selected by the plaintiffs. An execution appeared to have been put in by the Improved Electric Traction Co. as landlords of the garage, and the omnibuses in question were transferred to the Brighton Co.

Mr. Justice Neville asked whether the whole question was not in whom the property in the omnibuses was at the time they were transferred to the Brighton Co., and Counsel said that was so.

Evidence was called in support of the plaintiffs' case, and the hearing was adjourned until Thursday.

British Electromobile Co., Ltd.

In the Chancery Division on Saturday, February 4th, a petition was heard before Mr. Justice Swinfen Eady of in *re* the British Electromobile Co., Ltd., and Reduced. Counsel stated that it was a petition for a reduction of the capital of the company by £1,000 in respect to certain shares for that nominal amount which had been surrendered to the company. The capital of the company was £21,072, divided into £1 shares, and the proposal was to reduce that amount to £20,072 by writing off the £1,000. The reason for the reduction was that the company was established mainly for the selling and letting out of electric carriages, but that business had not been prosperous owing to the number of taxicabs and petrol cars. The company had met with more success in the making, &c., of the latter kind of car.

His Lordship made the usual order.

Railway Passenger's Claim.

At the City of London Court on 2nd inst., a leadworker named Folwell was awarded 10 guineas and costs against the Metropolitan Railway Co. for injuries received through a train being started while he was on the footboard, so that he was thrown to the ground. From the evidence for the defence, it appeared that from 30 to 60 seconds were allowed at each station, according to the time of day and the traffic.

Judge Lumley thought that a reasonable time ought to be allowed for passengers to get in and out of the cars.

Sheffield Tramcar Accident Claim.

A Sheffield master-painter, Thomas Peters, while driving a trap tried to get off the tramway track to allow a car to pass, but his pony was frightened by a heap of mortar at the roadside, and swerved back on to the track. The following car caught the trap, and the occupant was flung out; the trap was thrown on to the other track, and a car coming from the opposite direction damaged it, and crashed into the pony, so injuring it that it had to be killed. His Honour Judge Benson, at the County Court, awarded Peters £50 damages for his personal injuries and losses, remarking that it was the duty of the driver of one vehicle which was overtaking another to keep at a safe distance. He was satisfied that there was negligence in this respect.

Action Against the L.C.C.

On Thursday, February 2nd, in the King's Bench Division, Mrs. Clara L. Brown, a widow, of Wandsworth, sued the London County Council for damages for injuries caused to her by the alleged negligence of defendants' servants. Plaintiff is 65 years of age, and on May 21st, 1910, she was a passenger in a tram near Denmark Hill,

S.E. She had mounted the car, and was on the footboard, when the conductor whistled and the car stopped suddenly, throwing her into the interior, and injuring her. The defence was that the plaintiff had had plenty of time to go into the interior, and that the car was suddenly stopped by the driver to avoid running over a boy who ran in front of it. The jury found for the plaintiff, with £75 damages.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Siemens Cast-Iron Dividing Box.

Messrs. Siemens Bros. & Co., Ltd., of Caxton House, Westminster, are supplying a special type of cast-iron dividing box, for use in exposed positions, such as on overhead transmission poles, &c. The illustration shows one of these boxes attached to a wooden post. The incoming cable enters through a brass wiping gland, and is connected to special angle fittings, from which bare copper rods are led out obliquely through substantial insulators at the bottom of the box. The insulators are protected by a weather

Fig. 1.—Siemens Dividing Box.

shed formation of the lower portion of the casting, which prevents the collection of snow or other conducting substances between the live terminals. The two halves of the casting are provided with a machined facing, to ensure watertightness, and after the connections are completed the whole box is filled with hard insulating compound. These boxes are supplied both for high-tension and low-tension work.

New Lampholder.

We have received from the "Kingolite" Co., of 120, Wardour Street, W., a sample of their new patent lampholder, which is ingeniously held together by a couple of spring plungers. Two small plungers project outwards, one on either side of the porcelain interior. The brass cap for the cord grip, the brass cover with the bayonet slots for holding the lamp, and the shade-carrier are in turn slipped over the depressed plungers, and locked in position by the latter expanding through small holes suitably placed in the parts mentioned. The design is exceedingly simple and compact.

Festoon Lampholder.

We have received from Mr. E. C. Sear, of 16, Devonshire Square, E.C., a neat lampholder of registered design, intended for temporary wiring work, such as will be much in evidence during the coming months for decorative illuminations.

The brass cover containing the bayonet sockets is attached by a screw-ring to a special cap, in which two slot-holes are provided. The flexible is inserted in the slots on either side, bared, and looped into the top of the porcelain in the usual way.

Centrifugal Pump.

We illustrate herewith a single-stage double-inlet type centrifugal pump, recently manufactured by Messrs. E. Scott & Mountain, Ltd., of Gateshead-on-Tyne, for a northern firm. The pump

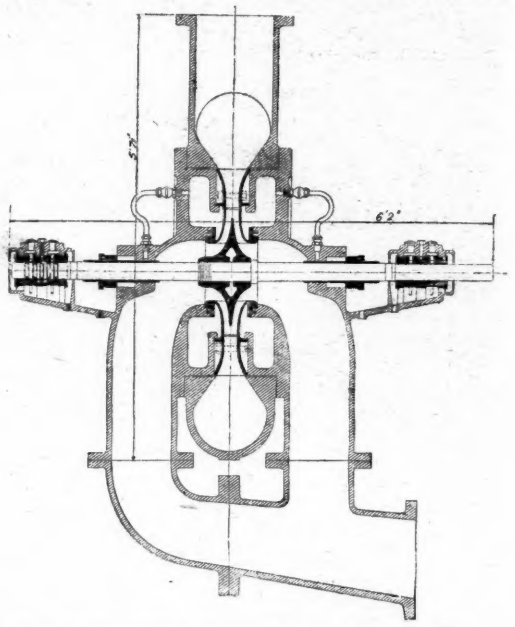

Fig. 2.—Sectional View, Scott & Mountain Pump.

delivers 3,000 gallons per minute against a head of 170 ft., and is driven by a 50-cycle 2,750-volt three-phase motor.

The impellers and diffusers are of hard bronze, and are so arranged that they can be readily renewed; the spindle is of nickel steel, gun-metal bushed where exposed to the action of the water, and

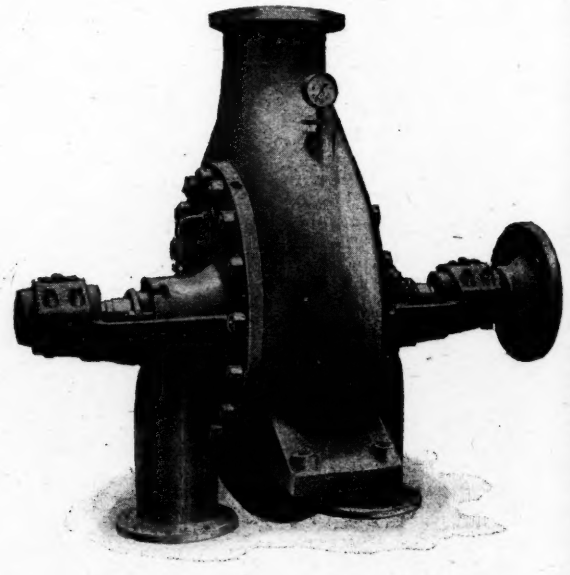

Fig. 3.—Exterior, Scott & Mountain Centrifugal Pump.

runs in self-oiling bearings. A special design of balancing-disk is provided, consisting of a pressure plate of gun-metal working against a machined face, the pressure on this plate counteracting the pull on the suction. The pump, of which we publish a section, can be taken apart to allow of the working parts being inspected, without disturbing the rising main.

Large "Onewatt" Lamps.

Messrs. Siemens Bros. Dynamo Works, Ltd., of Tyssen Street, Dalston, N.E., are now placing on the market 400-c.p. "Onewatt" lamps in bulbs 12 in. long by 8 in. diameter. These lamps are of precisely the same type as the 100 and 200-c.p. lamps which have been on the market some little time; the filaments are of drawn tungsten wire, wound on a "tantalum"-pattern spider. The efficiency will be approximately one watt per c.p., and they will be supplied with "Goliath" Edison screw caps. The firm are

also listing "Goliath" Edison screw holders in polished brass and porcelain, which will be suitable for use with the lamps in question.

A Quarter of a Century's Instrument Making.

Messrs. Cecil Hodges & Co., Ltd., of Balfour House, Finsbury Pavement, E.C., who this year celebrate their 25th anniversary, must be congratulated on their achievement. Few firms were making a study of electrical instruments in this country when they

Fig. 4.—Hodges Ammeter.

commenced the manufacture of their various types. An ordinary ammeter or voltmeter in those days cost over £2; to-day Messrs. Cecil Hodges are selling the same instruments for less than half that price, and claim that they embody better work and materials, owing to the special tools employed in making all parts interchangeable. Fig. 4 shows the latest type of Messrs. Cecil Hodges and Co.'s instrument, embodying all the improvements that long experience has suggested.

Although instruments have always been an important department with this firm, they have long been making a special feature

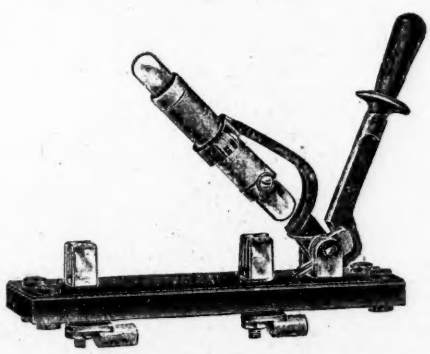

Fig. 5.—Combined Switch and Fuse.

of switchgear, and our second illustration shows a neat device combining switch and fuse on one arm, which takes up less room than the usual form of separate switch and fuse.

New Cutting Pliers.

Messrs. T. A. Mackereth & Co., of 10, Meersbrook Bank Road, Sheffield, have introduced a new type of cutting-pliers for electrical wiremen, cable jointers and winders; they are only 5½ in. long, and are warranted to cut copper wire ¼ in. in diameter or strip-copper

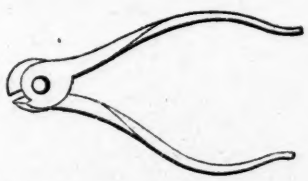

Fig. 6.—Mackereth Cutting Pliers.

¼ in. × ⅛ in. One of the chief features of these pliers is that they will cut a wire or strip square across the end, so that there is no need for the use of a file. A number of these have been purchased by the Sheffield Corporation Electric Light Department, and, we are informed, are giving every satisfaction.

"Philips" Candle Lamps.

Messrs. G. M. Boddy & Co., of 15, Gray's Inn Road, W.C., who are agents for the "Philips" metallic-filament lamps (not "Philips U.K.," as stated in our last issue), formerly sold as "Metalik" lamps, are introducing some candle flame and tubular "Philips" lamps for voltages of 25 to 55 volts, 10 to 16 c.p., and 66 to

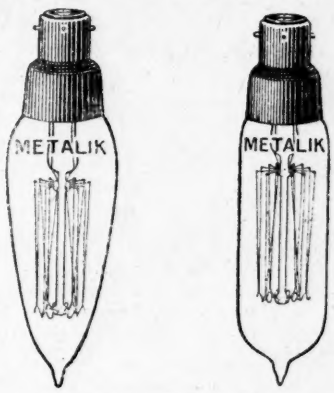

Fig. 7.—"Philips" Candle and Tubular Lamps.

135 volts, 16 c.p. These patterns are shown in the accompanying illustrations. The lamps are of similar construction to the anti-vibration type recently put on the market by this firm, for which very high qualities are claimed. We are informed that under the name of "Metalik" the "Philips" lamps have attained a high reputation in every quarter of the world.

BUSINESS NOTES.

Thermit Australian Patents.—We are informed that the case of Goldschmidt *v.* Chinn was recently brought before the Supreme Court of Sydney. We understand that defendant (of Adelaide) had made offers to carry out the welding of tramway rails, &c., by means of the alumino-thermic process. He was proceeded against for infringement of the patents, by the inventor, Dr. Hans Goldschmidt, of Essen-Ruhr. The defence asserted that, owing to various defects, the patent was invalid. The Supreme Court of Sydney on October 20th last decided that the objections to the validity of the patent failed, and that the defendant was guilty of infringement. An injunction was granted restraining him from further infringement and ordering him to pay the costs of the suit. No inquiry as to damages was asked for.

Catalogues and Lists.—Messrs. Siemens Brothers Dynamo Works, Ltd., Caxton House, London, S.W.—Well bound, convenient-sized catalogue of 180 pages, giving very full information, with illustrations, dimensioned drawings, tabulated prices, &c., of various electrical machines. There is a thumb index to 21 sections, and a key to this index appears at the beginning of the book. The manufactures covered in the course of these sections may be briefly indicated by reference to this key:—Continuous current and three-phase generators, continuous current, single, two and three-phase motors, electric fans, starters and regulators for c.c. and a.c. machines, motor starters, automatic starters, drum-type starters, switch-boxes and motor control panels, mining and other pillars, spare parts and accessories.

Mr. C. H. Blume, Western Road, Mitcham, Surrey.—Leaflet relating to insulating varnishes for electrical purposes, of which he makes a speciality. We have also received a very useful Telephone Slate Tablet whereon to keep a record of our most frequent "telephone communicants."

Messrs. Dobbie & McInnes, Ltd., 57, Bothwell Street, Glasgow.—Revised edition of a number of circulars dealing with the following specialities and other manufactures of the firm:—Messenger's furnace deformation indicator for gauging the circularity of boiler furnaces and cylinders; the "Hopkinson" flashlight engine indicator; McInnes-Dobbie Bourdon gauge; and the Clyde furnace indicator. Two separate catalogues are entitled "McInnes-Dobbie indicators" (fully descriptive and well illustrated), and "The Commercial Value of Indicator Diagrams and Instructions for the Use of the Engine Indicator."

Messrs. J. C. Lyell & Co., Ltd., 113, Great Portland Street, London, W.—Catalogue containing illustrated particulars of the "Clair" silencer and cut-out for motor-cars, the "Zulu" change-over switch, small electric drilling machines, &c.

Messrs. Krupka & Jacoby, 11, Queen Victoria Street, London, E.C.—Advance price leaflet of "Graetzin" metal-filament lamps; also a leaflet describing the "Sucleen" vacuum cleaner.

Messrs. Aland & Co., 203, Great Dover Street, London, S.E.—Illustrated price leaflet of their improved high-pressure fan blower.

Messrs. Eyquem's Patents, 10, Dean Street, Oxford Street, London, W.—Circular describing the "Universal" combined soldering iron and blow-lamp, and giving instructions for its use.

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SIEMENS BROS. DYNAMO WORKS, LTD., Dalston.—Price leaflet dealing with "Onewatt" lamps having drawn tungsten wire filaments up to 100 C.P., for street and shop lighting.

ENGINEERING DEPARTMENT OF THE NATIONAL ELECTRIC LAMP ASSOCIATION, Ohio, U.S.A.—Bulletins relating to "Mazda" miniature and low-voltage lamps, tantalum multiple lamps, and electric sign lighting.

Circus Lighting.—Osram lamps are now used for the lighting of Hengler's Circus at Glasgow, the installation including 10 1,000-watt, nine 400-watt, two 100-watt, 25 55-watt, and 140 32-watt lamps.

Bankruptcy Proceedings.—ISIDOR FROHWEIN, manufacturers' agent, late of 93, Aldersgate Street, E.C.—Under this failure the first meeting of creditors was held last Friday at the London Bankruptcy Court before Mr. Daniel Williams, Assistant Official Receiver. It appeared that the debtor commenced business in 1903 as a wholesale dealer in electrical goods and manufacturers' agent in partnership with one Leesler. The debtor provided £700 and his partner £300 as capital. They traded as the New Electric Novelties Co., at 69, Goswell Road, but prior to starting that business they had a factory in Cologne for electrical batteries, which was fitted up with machinery and plant at a cost of £2,000, provided by them in equal shares. The business in Germany was only continued for eight months after the debtor came to England, and was closed because it did not pay. The plant and machinery were sold for £1,500. At the end of 1904 the Goswell Road premises were pulled down, and the business was removed to 18, Paper Street. Six months later the partnership was dissolved, the partner taking over the assets and liabilities and paying the debtor about £180 for his interest in the concerns. For a time the debtor was employed as a traveller, but in May, 1908, he entered into a verbal partnership with one Rudolph Fiebig, and started business at 13, Wells Street, Oxford Street, as Fiebig & Frohwein. That partnership was dissolved in November, 1908, and the debtor subsequently continued the business alone until June, 1909, when he removed it to 93, Aldersgate Street, and entered into partnership with Mr. A. Lange, the petitioning creditor, who introduced a capital of £700. The partnership was severed in November, 1909, Mr. Lange retiring, and the debtor continued the business alone until the early part of May, 1910, when, as he had neither money nor stock, he closed it and went into employment. The debtor attributes his failure to the action of the petitioning creditor, who obtained judgment against him for damages and costs. A statement of affairs was lodged showing liabilities £445 (unsecured £415) and no assets whatever. In the absence of any proposal the case was left with the Official Receiver, to be wound up in the ordinary course of bankruptcy, the debtor's public examination being fixed for March 2nd. The following are the principal creditors :—

UNSECURED.

A. Lange, New Southgate	£200
Aquis Property Co., London	20
Mrs. Frohwein, London	26
— Seigbert, Cologne	50
Carl Fiebig, Berlin	50
S. Davis & Co., London	10
F. W. Lehver, Berlin	50

FULLY SECURED.

Provincial Union Bank (security estimated at same amount).	£30

LUDWIG LEHMANN, merchant, Basinghall Street, E.C.—A meeting of those interested in this case was reported in our issue of January 20th, p. 95. According to the *Times* the first meeting of creditors was held at Bankruptcy Buildings on February 1st under a receiving order made on January 19th. Mr. E. H. Hawkins was appointed trustee of the estate, with a committee of inspection.

VALENTINE GEORGE BURKITT (V. G. Burkitt & Co.), electrical engineer, 38, Park Row, Bristol.—Receiving order made February 3rd, on a creditor's petition.

JOSEPH PERKINS, electrical engineer, Plymouth.—First meeting, February 16th ; public examination, March 1st.

Book Notices.—*Annales des Postes, Télégraphes et Téléphones.* December, 1910. Paris : A. Dumas. Price 6 fr.—The contents of this number include articles on the protection of telegraph lines against earth currents, by M. E. Montoriol ; the telephone system of London, by M. Gilles ; electric lighting, by M. Laporte, and the international conference on telegraphs and telephones of 1910.

"*Proceedings* of the Rugby Engineering Society." 1909-10. Rugby : The Society. Price 10s. 6d.—This number contains papers on "Shop Testing of Direct and Alternating Current Machinery," by J. W. Rogers ; "Factory Organisation," by J. Rider ; and "The Electric Furnace," by J. Harden.

Contact Resistance between Commutator and Brushes.—In a pamphlet under this title the Electrical Co., Ltd., gives an interesting account of the manner in which the difficulties due to contact resistance in D.C. ampere-hour motor meters have been overcome by the introduction of self-adjusting brushes, in conjunction with a twisted commutator. With the aid of a small coil connected in series with the armature, the brushes are shifted longitudinally on the commutator whenever the armature current varies, and by spiralling the commutator segments the axis of commutation is also varied as the load varies, giving a ready means of applying a correction to the calibration curve, while rendering the meter sensitive to voltage variations, like a watt-hour meter.

Old Students' Association Magazine, December, 1910.—The magazine of the Finsbury Technical College, O.S.A., contains articles on "The Telephone in Egypt," "Economical Ferro-Concrete," "The C.M.B. Converter," "Opportunities for Employment," &c., and makes a very good issue.

"Gas Engines." By W. J. Marshall and Capt. H. R. Sankey, R.E. 1911. London : Constable & Co., Ltd. Price 6s. net.

"The Inventor's Adviser and Manufacturer's Handbook to Patents, Designs and Trade Marks." By Reginald Haddan. Eighth Edition, 1911. London : Harrison & Sons.

"*Bulletin* Scientifique de l'Association des Elèves des Ecoles Speciales." January, 1911. Liége : Imprimerie Moderne. Price 0·75 fr.

"*Proceedings* of the American Society of Civil Engineers. Vol. XXXVII, No. 1. January, 1911. New York : The Society.

"The Law Relating to Electrical Energy in India : being the Indian Electricity Act, 1910. By J. W. Meares. Calcutta : The Government Central Press. Price 15s. net.

"*Bulletin* Mensuel de la Société Belge d'Electriciens." December, 1910. Brussels : Ramlot Frères.

"Boletin de Ingenieros." Vol. 1, No. 5. 1911. Mexico : Secretaria de Guerray Marina.

"*Journal* of the Western Society of Engineers." Vol. XV, No. 6. December, 1910. Chicago : The Society. Price 50 cents.

"*Proceedings* of the Engineers' Club of Philadelphia." Vol. XXVIII, No. I. January, 1911. Philadelphia : The Club's Offices. Price $2.00.

The excellent series of Cantor Lectures on Industrial Pyrometry, recently delivered by Mr. C. R. Darling before the Royal Society of Arts, has now been issued in pamphlet form at the price of 1s. Naturally the bulk of the lectures is devoted to the discussion of electrical methods, which have so largely displaced all other systems.

Messrs. Whittaker & Co. have just issued a new edition of "Electric Wiring, Fittings, Switches and Lamps," by Mr. W. Perren Maycock. The work, which has been entirely rewritten, now comprises 628 pages and 624 illustrations ; and, in addition to the subjects indicated by the title, deals with specifications, electric heating, bells, telephones, fire alarms, testing, &c. A companion book, "Electric-Wiring Diagrams," forms a collection, with concise explanations, of most of the numerous connection diagrams given in the larger work above-mentioned.

Tube Station Lighting.—"Onewatt" high-C.P. lamps in conjunction with special Holophane fittings have been approved for use on all stations of the Great Northern and City Railway to replace the ordinary arc lamps already installed. One of these stations has already been completed, and the others are to be proceeded with immediately.

Walsall Circuit-Breakers.—The WALSALL ELECTRICAL CO., LTD., have recently installed their master switches controlling circuit-breakers at two steelworks—the Glanmore Steel and Iron Foundry, Llanelly, with a 1,500-ampere D.P. circuit-breaker, and the Earl of Dudley Round Oak Works, on a 500-ampere circuit—with satisfactory results ; a repeat order has been received from the last-named works. The master switch, which was described in our issue of October 14th, 1910, is operated by a shunt current, and no main current is used for operating the circuit-breaker either on overload or reverse current.

Dissolutions and Liquidations.—MESSRS. SPENCE AND IONIDES, consulting engineers, of Glasgow, have dissolved partnership as from January 31st. Mr. Wilfrid L. Spence is continuing in business as a consulting engineer at the same address—30, George Square, Glasgow. Telegrams : "Electrify, Glasgow" ; telephone, Nat. 8,080 City.

HOWE ELECTRICAL ENGINEERING CO., LTD.—This company is winding-up with Mr. A. Thraves, 7, Victoria Street, Liverpool, as liquidator.

JESSON, BIRKETT & CO., LTD.—Creditors must send particulars of debts, &c.. to the liquidator (Mr. G. J. Bowker, Queen's College, Paradise Street, Birmingham), by February 28th.

MESSRS. MACLAREN & GROOME, electrical and mechanical engineers, 28, Lowlands Road, Harrow.—Messrs. J. H. MacLaren and J. A. Groome have dissolved partnership. Debts will be attended to by Mr. MacLaren, who continues the business.

Staff Dinner.—The second annual staff dinner of Ferranti, Ltd., was held on Friday, February 3rd, at the Midland Hotel, Manchester, under the chairmanship of Mr. A. Bruce Anderson. Covers were laid for 140, and among those present were Messrs. S. Z. de Ferranti, A. W. Tait, Arthur Whittaker and Wm. Jones, all of whom are directly or indirectly connected with the company. Mr. S. L. Pearce, city electrical engineer, was also present. After the toast of the King, Mr. Anderson proposed "The Ferranti Co.," in a speech full of humorous suggestions, in which he gracefully passed from past to present in reviewing the vicissitudes of the company, and at the close announced the receipt of a telegram to the effect that a single consignment to abroad of 1,104 meters had been dispatched that very evening, with the comment that this was only a sample of what the company could do and were doing. Mr. Tait and Mr. Ferranti replied to this toast, the latter speaking of Hollinwood in feeling terms, adding that he always felt that in coming to Manchester he was coming home again. "The Visitors" were toasted by Mr. Whittaker in the unavoidable absence of Mr. J. M. Henderson, M.P., and Mr. Pearce and Mr. Jones responded. An excellent musical programme was provided by the staff and visitors.

Germany's Trade in Incandescent Lamps.—In a report on the development of electric lighting in Germany, which is quoted by a Birmingham newspaper, the United States Consul at Bremen says Germany has a tremendous export trade in incandescent lamps, and it is growing every year. In 1907 it was £400 000 in value, in 1908 it was £875,000, and in 1909 it reached £1,570,000. The shipments are mostly to Great Britain, Austria-Hungary, Russia, Denmark and Italy.

Coronation Exhibition.—The first meeting of the Grand Council of the Coronation Exhibition, to be held this year at the Great White City, Shepherd's Bush—which consists of more than 2,500 distinguished members, including 700 members of the House of Lords and House of Commons—was held on Wednesday last week in the Whitehall Rooms of the Hotel Metropole. Lord Blyth, who acted as chairman of the Organising Committee of the Franco-British Exhibition and chairman of the Grand Council of the Japan-British Exhibition, presided. In his opening speech, Lord Blyth alluded to the magnificent success of last year's Exhibition, and said that he hoped the Coronation Exhibition, held, as it will be, in a year when millions of people will visit London from all parts of the globe, would surpass in every way even its world-famous predecessors. He was intensely interested in the work of the Exhibition, and looking at it as he did from a commercial point of view, he regarded these exhibitions as a means of developing trade, and, this year, of intensifying the interest of the world in our great empire. "Many millions of our money," he said, "are invested in foreign countries, because those countries are much more enterprising than we are in displaying their products and manufactures. This Exhibition is intended to bring the manufactures of the empire in iron, steel, ivory, gold, and other precious metals before the masses of our own people and the people of other countries. At the Coronation Exhibition there will be seen the cleverest artisans and the most skilful mechanics from all parts of the empire actually engaged in their own handicrafts. Visitors will see at the Coronation Exhibition the work of the empire carried on amid realistic and typical scenery of superb magnificence."

Mr. Imre Kiralfy said that never in his experience had an exhibition such support as that which "the Coronation" was receiving. Royal, scientific and art societies and institutions were showing intense interest in their own departments and were conspiring to produce such an exhibition as should be instructive, entertaining, and the admiration of all. Mr. Kiralfy pointed out that most of the chairmen of the Chambers of Commerce of the United Kingdom, the Lord Mayors and Mayors, and the Lord Provosts of important towns had joined the Council. The Transportation Committee, he said, which did so much to bring passengers and exhibits to the Exhibition, included the chairmen and general managers of the principal railways. Under the direction of Sir Alexander Pedler, F.R.S., the scientific section this year would be of the most perfect character.

Mr. Bathurst, M.P., said that there would undoubtedly this year be a large influx of visitors from all parts. He hoped we should take to heart the famous words of our present king when he said "Wake up, England," and that the Coronation Exhibition would show the vastness of our resources and industries.

Trade Announcements.—The British Prometheus Co., Ltd., announce that Messrs. Simplex Conduits, Ltd., Birmingham and branches, are no longer agents for their specialities. Orders sent direct to the company at Salop Street Works, Highgate, Birmingham, or to the London showrooms (9, Newman Street, Oxford Street, W.), will receive immediate attention.

The offices of the Empire Roller Bearings Co., Ltd., have been removed from No. 15 to more commodious premises at No. 17, Victoria Street, S.W.

Owing to increasing business in the Lancashire and Yorkshire districts, the Electric and Ordnance Accessories Co., Ltd., have appointed an engineer (Mr. F. MacCallum, late of J. P. Hall and Co., Oldham) to represent them exclusively in Yorkshire. Mr. J. Booker, the company's Manchester engineer, is now confining himself to the Lancashire district. Mr. MacCallum has had many years' experience in the application of electric power, particularly as applied to industrial requirements.

LIGHTING and POWER NOTES.

Aberdeen.—The Corporation Electricity Committee, last Friday, considered the report of Mr. J. A. Bell, electrical engineer, with reference to the need for an extension of the electricity station in Crown Street to cope with the autumn and winter load of this year. The estimated cost of the extension, including £5,450 for a 1,000-kw. high-pressure turbine, D.C. dynamo and condenser, is £7,285. The report was unanimously agreed to.

Accrington.—The Electricity Committee has sanctioned writing off from the depreciation and renewals fund a sum of £2,156 for the cost of provisional orders and secondhand machinery. After this charge has been made the fund stands at £3,094. The cost of provisional orders was as follows:—Church, £86 13s.; Clayton-le-Moors, £50 11s.; Haslingden, £25 10s.; total, £162 14s. Secondhand machinery, &c., £1,993 10s. The balance in hand is £938.

Ashford (Kent).—The U.D.C. on February 2nd decided to consent to a prov. order for E.L. being applied for by the East Kent Electricity Supply Co. on the Council's costs for objections being paid. The Council has asked that the purchase powers should be extended to the outlying parishes included in the order.

Bognor.—At a meeting of the U.D.C. on Friday, a letter was received intimating that the Chichester E.L. and Power Co., Ltd., did not intend to proceed with its application for a prov. order for electric supply in Bognor.

Burton-on-Trent.—The L.G.B. is to be asked to sanction the borrowing of £1,200 for services and £550 for transformers.

Continental Notes.—Russia.—The Société Metallurgique de Tagonrog is increasing its capital with the object of establishing a large electricity generating plant in connection with its iron and steel works at Tagonrog, Russia. The plant, which will be utilised to supply the current for the driving of the various pumps, fans and blowers about the works, as also the majority of the rolling mills, will comprise two 2,000-kw. steam turbines and alternators, and two 2,160-kw. gas engines and dynamos.

Germany.—An application has been made to the Baden Government by Brown, Boveri & Co. and two other firms for sanction to establish hydro-electric works near Schworstadt, but the request has been refused. In the first place, the rejection is based upon the circumstance that the Baden Railway Administration has reserved for itself the right of utilising the water-power available near Schworstadt in the event of electrical working being introduced on the Baden railways. Secondly, the Government entertains doubts as to granting concessions for further hydro-electric works on the Upper Rhine, as the three new power works at Laufenburg, Augst-Wyhlen and Kembs have hitherto experienced difficulty in finding customers for the power.

The Gesellschaft Elbtal Zentrale Pirna is the name of a new company which has lately been formed at Pirna under the auspices of the A.E.G., with a capital of £125,000, to establish a large central electricity generating station.

Coventry.—The T.C. has decided to apply to the L.G.B. for a loan of £9,713 for extensions of the electricity undertaking.

Crewe.—The Lighting Committee has been asked to consider the question of placing arc lamps in Market Street, and the matter is to be dealt with when the street improvement is completed.

Croydon.—The B.C., on the recommendation of the Lighting and Electricity Committee, resolved on Monday to oppose the Metropolitan District Railway Bill, on the ground that, *inter alia*, it seeks under certain circumstances to supply electricity within a radius of 15 miles from Charing Cross.

The B.C. also decided to apply to the L.G.B. for sanction to a loan of £10,000 for electric lighting purposes, viz., new mains, £9,500; transforming plant, £500. The last sanction was on June 25th, 1908, and the total capital expenditure to December 31st, 1910, was £162,212.

Dartford.—At the meeting of the U.D.C. on February 2nd, instructions were given to prepare specifications and obtain tenders for an additional generating set of 600 B.H.P. for the electricity works, and that superheaters be fixed to three boilers.

Dover.—The T.C. has decided not to proceed further with a proposal that the management of the electricity and tramway undertakings should be vested in Balfour, Beatty & Co., Ltd., for 10 years. The firm informed the Council that it considered that with an expenditure of about £1,000, there could be a saving of over £2,000 per annum on the running of the electricity undertaking, and that the net revenue from the tramways could be increased. The remuneration it asked for was 50 per cent. of the increased net revenue up to £1,500 per annum; 25 per cent. of the increase over £1,500 per annum up to a maximum of £3,000. Reports on the undertakings have been prepared by the electrical engineer and the general manager of the tramways as to savings that can be effected, and have been referred to the respective Committees.

Dublin.—The Electricity Supply Committee of the Corporation has prepared a report recommending the Council to apply to the L.G.B. for a loan of £128,129 for further extensions to the electricity undertaking, the progress of which, it says, has been so rapid for the past 12 months that it will be necessary to install further plant at the Pigeon House station, and to correspondingly enlarge the distribution system, in order to cope with the increasing demand. The progress of the electricity department was, the Committee say, brought almost to a standstill by the introduction of metallic lamps, which inquiries made by the officials show were more rapidly availed of in Dublin than in almost any other city. At the L.G.B. inquiry held in June, 1909, the evidence given on behalf of the Committee was, that, while the effect on the electricity undertaking had been more quickly felt in Dublin than elsewhere, the stoppage of the progress was more quickly got over, and that the Committee believed that from that time forward the undertaking would again continue to progress. This opinion, the Committee say, is borne out by an analysis of the electricity accounts for the year ending March 31st, 1910. In applying to the L.G.B. for a further loan, the Committee thinks it would be a mistaken policy to limit the application to the absolutely necessary requirements for the present day. As estimated by Mr. Ruddle, the city electrical engineer, the demand for next winter can be met by an additional expenditure of £55,000, the greater proportion (£33,000) of that sum being for a further installation of plant at the Pigeon House, which is immediately necessary. As a safeguard,

the Committee considers that not only should the amount of the loan so urgently required for expenditure this year be applied for, but that any application made to the Board should cover the probable capital requirements for the next three years, and these requirements are estimated to work out as follows:—Expenditure (already incurred) in excess of amount applied for in 1909 on short extensions, house services, meters, &c., £10,129; extensions of plant in 1911, £40,000; new high-pressure feeder mains from Pigeon House to Fleet Street, 1912, £9,000; short extensions, house services, and alterations to distribution system, 1911, £15,000; short extensions, house services, and alterations to distribution system, 1912, £15,000; short extensions, house services, and alterations to distribution system, 1913, £15,000; second additional set of plant probably required by 1912, £24,000; total, £128,129.

Eastbourne.—The electrical engineer and the borough surveyor are to bring up a report as to the cost of lighting Seaside (near the Archery) and The Avenue with metal-filament lamps, as compared with gas. As the supply for the Coronation decorations will be required when the machinery is running under the lightest load, and at a time when the majority of the shops are closed, the price has been fixed at 3d. per unit. Tenders are to be invited for the work of a large scheme of festoon lighting to be undertaken by the Corporation.

Eccles.—The T.C. has decided that no action shall be taken at present with regard to the wiring of private premises by the Council.

The Corporation proposes to install a 500-KW. steam engine and alternator at the electricity works.

Elland.—Messrs. H. Leetham & Sons, millers, of York, have asked the U.D.C. to submit terms for supplying energy to the Elland Flour Mills, Ltd., Woodside.

Glasgow.—The tramways and electricity departments of the T.C. are inversely affected by the visitations of winter fogs. Last week the murky impenetrable fog lay over the city for four days, and its effects were apparent in the huge increase in the consumption of electricity for lighting and the considerable diminution of the revenue from the tramways. The latter department, through delays and fewer numbers of passengers during the four days, lost over £1,000, the heaviest drop compared with the drawings on the same day of the previous week being £360 on Friday. In the electricity department there was a record output on Friday. The normal is 200,000 units, but on Wednesday the figures expanded to 260,000 units, and on Friday to 266,000 units, both being considerably above the record established in November of 1909.

Hayfield and Mellor.—The R.D.C. proposes to approach the Glossop and Dale R.D.C. in order to ascertain whether they will co-operate in an effort to inquire into the feasibility of utilising the River Goyt for the generation of electricity, and to inquire as to the cost of such a scheme.

Kendal.—The T.C. has decided to apply to the L.G.B. for sanction to borrow for the purposes of the electricity undertaking the sum of £1,470 (which is in addition to £1,976 previously authorised). The details of the amount required are as follows:—Galloway boiler, and seating, &c., £480; buildings, £60; 100-KW. steam engine and dynamo, including panel, £750; for increasing size of heater, £50; extra for chimney of brick, £50; and contingencies, £80.

London.—The Joint Conference of London Electric Supply Authorities has passed the following resolutions:—(1) That with a view to further developing the commercial side of the electric supply undertakings of London, the Conference co-operate with the Electric Supply Publicity Committee, particularly with a view to raising a special fund of about £1,500 for advertising, including an extended display of large-size posters on the principal hoardings throughout London; (2) that the joint secretaries invite those Borough Councils and companies' undertakings not at present represented on the Joint Conference of London Electric Supply Authorities or on the Electric Supply Publicity Committee, to contribute to such fund.

The Associated Municipal Electrical Engineers of Greater London have considered the matter as to the charge to be made for energy supplied to the illuminations for the Coronation, and each engineer has agreed to recommend his authority to fix the charge on the basis of 1d. per unit with a fee for testing, connecting and disconnecting of 5s. It is believed that it will be a great advantage to wiring contractors and manufacturers to know of these cheap rates at an early date.

BERMONDSEY.—The Electricity Committee reports that objections have been lodged with the Board of Trade against the Council's application for a prov. order for the district of St. Olave, St. John and St. Thomas, by (1) the London Electric Supply Corporation, and the County of London Electric Supply Co. (in joint opposition): (2) the South Metropolitan Gas Co.; (3) the L.C.C.; (4) the Municipal Association. The L.B. & S.C. Railway Co., and the South-Eastern Railway Co., lodged objections, but have now withdrawn them on being given the same protection clause as was agreed to when the order was applied for in 1907. Metallic-filament lamps are to be installed at the Rotherhithe Town Hall at an estimated cost of £73 16s. A two-rate meter is to be installed in the Bermondsey Town Hall, charging 1½d. and 3½d. per unit. The cost of energy consumed last year was £231, and it is estimated that with the two-rate meter, and including the energy consumed by the radiators, the cost will be reduced to £190. The clock tower at the Rotherhithe Town Hall consumes 2,932 units per annum. The current in future is to be charged at the same rate as the public lighting, viz., 1¾d. per unit. This will result in a saving of about £21 per annum.

STEPNEY.—Application is to be made to the L.C.C. for a loan of £3,060 for house service lines. The Electricity Committee reports that negotiations have passed between it and the Port of London Authority with respect to the supply to that authority of electricity and the granting of wayleaves under dock entrances for the laying of cables in connection with the supply of electricity in the Wapping area, and that there is every reason to believe that the Port Authority will shortly be entering into an agreement with the Council covering these matters.

Newcastle-on-Tyne.—At a meeting of the T.C. on the 1st inst., Mr. de Loriol submitted a report on the lighting of the Quayside, where extensions are being carried out at a cost of about £100,000. The Trade and Commerce Committee (of which Mr. de Loriol is chairman) recommended that the Quay be lighted electrically, the total annual cost being estimated at £291. The Watch Committee had agreed to pay one-half of this sum. The capital cost of the electric lighting installation was estimated at £900. Mr. de Loriol said there was an absolute necessity for better lighting, and it was an anomaly that although they had spent already £88,000 on the Quayside, they had done nothing to improve the lighting of it. He pointed out that the Tramways Committee had spent £700 on laying the cables, and the Commerce Committee had considered whether they should light the Quay by gas or electricity, and had decided to use the latter. The cost would be £54 per annum more, but the actual cost would be only £264. The illumination at present was only 3,716 C.P., whereas under the new scheme it would be 52,500. The report was adopted.

Oldham.—At the meeting of the T.C. on the 2nd inst., Alderman Ward moved the adoption of the minutes of the Electricity Committee, embodying a resolution instructing the electrical engineer to prepare a specification for a mixed steam turbo-generator to be installed at the Greenhill station, at a cost, approximately, of £8,000. It was pointed out that there would be a saving effected of 30 per cent. in coal, and it was shown that the enlargement was necessitated by the present and prospective demand for current.

Oswaldtwistle.—The U.D.C. has declined to consent to Accrington T.C. supplying current to premises in the district.

Oulton Broad.—The U.D.C. has been informed that a prov. order for E.L. is to be applied for by the Oulton Broad Electricity Co.

Reigate.—Last year the Corporation retained Messrs. Handcock & Dykes to thoroughly investigate the working of its electric lighting undertaking, with a view to ascertaining what steps should be taken to place it on a more satisfactory footing. In an exhaustive report dealing with the plant and mains and also with the charges for current in force in the district, the engineers recommended, amongst other alterations, the provision of two 100-KW. Diesel engines and alternators, which would take the load during the greater part of the 24 hours. At the last meeting of the T.C., a resolution was passed instructing Messrs. Handcock & Dykes to prepare plans and specifications and take the necessary steps for the installing of the two new sets recommended.

Rotherham.—A sliding scale of charges for energy supplied to large consumers for lighting purposes is to be adopted: Up to 10,000 units per annum, the charge is to be 4d. per unit, while discounts, which increase gradually to 30 per cent. for above 40,000 units per annum, are to be given. The engineer has been empowered to give the above discounts to permanent consumers whose average consumption exceeds an equivalent of one hour per day on the total number of lamps installed. An order has been received from the B. of T. empowering the Council to supply energy to the Sheffield Simplex Motor Works and the British Abrasive Wheel Co., in the Parish of Tinsley. Tenders are to be invited for an additional turbo-generator at the generating station.

St. Helens.—The T.C. has applied to the L.G.B. for a loan of £10,800 for a turbo-generator of 1,500 KW., with an additional boiler and conveying plant.

The low-tension mains are to be extended overhead to the Sherdley Glass Works.

Sheffield.—An extra H.T. cable is to be laid from the Neepsend power house to Princess Street sub-station and Chapel Lane sub-station, a distance of 12,263 yd., at an estimated cost of £10,765. The general manager has reported to the Electricity Committee that the capital cost of lighting Attercliffe Road between Washford Bridge and the "Golden Ball" by means of flame arc lamps would be, for lamp fittings and services complete, £408. The total cost per annum would be £236, or per C.P. 1·67d. The cost of the existing gas lamps is £209 per annum, or a cost per C.P. of 6·11d. The Committee has decided, subject to the usual sanction, to substitute flame arc lamps for the gas lamps.

Shipley.—At last week's meeting of the District Council it was reported that one of the turbines had broken down and special repairs had been carried out, the cost of which would be from £100 to £130.

South Shields.—At a meeting of the T.C. on the 1st inst., on the recommendation of the Electricity Committee, it was resolved to reduce the charge for electric current for heating and cooking purposes from 2d. to 1d. per unit, the reduction to come into operation on April 1st.

Southborough.—The Tunbridge Wells T.C. has declined to accede to a request from the U.D.C. that a royalty of 5 per cent. on the income should be paid in consideration of the U.D.C. consenting to the Corporation supplying electricity to consumers in the urban area. The Tunbridge Wells T.C. will apply to the B. of T. under Sec. 6 of the E.L. Act, 1909, for an order empowering it to give the supply.

Spennymoor.—Owing to the difficulty experienced in arranging wayleaves, the County of Durham Electric Power Supply Co. has informed the U.D.C. that it has abandoned the overhead line proposed for the district, and will lay the cables underground.

Stourport.—The B. of T. has intimated its intention of revoking the prov. order of the Kidderminster and District Electrical Co., which has not been put into force within the prescribed period. The U.D.C. is opposed to this course, but has referred the matter to the consideration of a Committee.

Westhampnett (Sussex).—The R.D.C. on Friday last decided to consent to the application of the Chichester E.L. Co., for a prov. order to extend its area of supply to parishes in the Council's area, subject to the company agreeing to a clause to the effect that if, at the expiration of 10 years, the villages have not been supplied, the company shall not be in a position to oppose any other company or local authority proposing to supply energy to those parishes.

Winchester.—The T.C. on February 2nd sealed the agreement for the purchase of the undertaking of the E.L. Co. It was also decided to promote a Bill in Parliament for this purpose.

Worthing.—The resident electrical engineer has reported that it will shortly be necessary for additional plant to be put down in order to meet the demand for electricity, and has submitted alternative proposals for (1) steam plant at an estimated cost of £4,500; (2) Diesel engine plant at the estimated cost of £4,375; and (3) accumulator plant at the estimated cost of £2,940, together with information as to the relative advantages of each proposal; but the Electricity Committee, in view of the difference in the capital cost, recommends the T.C., before coming to any definite decision, to obtain the advice of a competent consulting electrical engineer as to the relative advantages of the schemes put forward, having regard to the particular requirements of the borough.

York.—The Electricity Committee has come to the conclusion that, in order to meet the requirements of the electricity department, the following additional plant, &c., is necessary—viz., a 1,000-KW. turbo-generator, water-tube boiler, pumps, transformers, switchboards, &c., estimated to cost £9,600, and extensions to mains, distributors, &c., estimated to cost £5,400, making a total of £15,000. The City Council is, therefore, being recommended to authorise the extension, and to apply to the L.G.B. for sanction to borrow this sum.

TRAMWAY and RAILWAY NOTES.

Ardsley.—The B. of T. has informed the U.D.C. that the time for the construction of the lines included in the Morley and District Light Railways Order has been extended to December 31st next.

Bradford.—Consideration has been given by a sub-Committee of the Tramways Committee to the matter of a suggested central tramway depôt, and the sub-Committee has decided to recommend the Tramways Committee to purchase land in the Longlands area for such a purpose. The estimated cost of the project is £46,000, though the saving in respect of certain small sheds would reduce this figure to about one-half. A similar proposal for the establishment of a central depôt had previously been made, but no action was taken in regard to it.

Brighton—Worthing.—The Tramways Committee of the West Sussex C.C. has decided to oppose the application by a company for powers to construct a tramway from Brighton to Worthing, *viâ* Lancing, Shoreham-by-Sea, Southwick and Portslade.

Bury (Lancs.).—At a meeting of the T.C. held on February 2nd, the recommendation of the tramways manager respecting the revised scale of pay for drivers and conductors was adopted. The following is the new scale:—First year, 5d. per hour; second year, 5½d.; third year, 5½d.; after three years, 5¾. The recommendation was agreed to, upon the understanding that for a period of at least three years no further applications were to be made in respect of the wages or conditions of labour of any of the employés in the department.

Continental Notes.—RUSSIA.—At a meeting held at the Department of Railways, a project was discussed for the construction of an electric tramway, 46 miles long, from Moscow to Troitsko-Sergievskiy. The cost of the undertaking is estimated at about £820,000, and it is proposed to form a company to carry out the work.—*Board of Trade Journal.*

The first step towards the introduction of electric traction on the Russian railway system has been taken by the Moscow-Windau-Rybinsk Co. An electrically worked engine has been put into service in Tsarskoie-Selo. The Minister of Ways and Communications is watching the experiment with great interest, and has expressed himself as very favourably disposed towards the extension of electric railway traction in Russia.—*Financial News.*

SWITZERLAND.—La Société des Chemins de Fer Rhetiques has decided to adopt electric traction on all its lines in the Engadine. The contract for the work, and for the supply of the necessary rolling stock, has been divided between the Oerlikon Co., the Siemens-Schuckert Works, the Alioth Co., the A.E.G., and Messrs. Brown, Boveri & Co.

GREECE.—A tramway strike is in progress in Athens, but traffic has been resumed on five lines. Patrols are guarding the routes, and armed soldiers ride on the cars.

Dublin.—A Newcastle-on-Tyne correspondent, in sending us the following information, asks why it is always an Irish Co. which starts a good thing. An interesting experiment in carrying cattle from South Dublin to the Cattle Market took place recently in the presence of a number of farmers. Cattle breeders have often complained of the loss in sale of stock resulting from driving the cattle over stone setts to the market. The Dublin United Tramway Co. was induced to take the matter up, and constructed three special cattle trucks for conveying cattle from points adjoining the Dalkey, Kingstown and Blackrock line. The trial from Blackrock proved a success, and in future a cattle train will run on Thursday mornings, probably from Dalkey.

Dundee.—A deputation from the Tramway Passengers' Association was heard at the T.C. meeting last week in regard to the appropriation by the Council of tramway profits in relief of the rates. One speaker claimed most emphatically that tramway profits belonged to the tramway passengers, and that any appropriation either to the common good or to the relief of rates was directly against the interests of the tramway undertaking itself. Attention was called to the fact that the Council was contributing £1,000 a year to the common good from the tramways, and that while the common good benefits were distributed over the whole community, the tramway revenue was raised by only a section of the community. The speaker showed that in the aggregate the tramways paid £5,500, which was equal to a relief of rates of nearly 1½d. per £1 sterling, and that as the large ratepayer was mostly a small tramway patron, the large ratepayer benefited. The deputationists asked that concessions be given to the regular tramway passengers in the shape of season tickets. It was unanimously agreed that the points raised by the deputation should be remitted to the Tramway Committee for consideration.

Glasgow.—Two proposed extensions of the T.C.'s system are at present before the Tramways Committee. One is for the linking up of the populous North Kelvinside district with the Botanic Gardens—Rutherglen service. This, however, involves the reconstruction of the Queen Margaret Bridge over the River Kelvin, and a conference of the various Committees interested is to take place. The other extension is from the present terminus at Bishopbriggs to Kirkintilloch, and the Committee has promised to give attention to the views expressed on the subject by a representative deputation of Kirkintilloch residents.

With reference to the arrangements by the tramways department in connection with the local festivities for the celebration of the Coronation of King George V., it is proposed by the Committee that the manager be instructed to make the necessary arrangements at a cost not to exceed £500. It is expected that the scheme to be adopted will be the running of illuminated and decorated cars.

The Sub-Committee on Tramways Finance is to consider and report on the whole question of carrying parcels upon cars.

Huddersfield.—The new Kavanagh design of car, which was recently introduced on the tramway system, is attracting a good deal of attention, and numerous deputations from other municipalities have visited Huddersfield for the purpose of inspecting the car. On Thursday last the chairman of the Leeds Tramways Committee, and other gentlemen, went over to Huddersfield to look at the car.

Leeds.—A conference has been convened of representatives of the Leeds and Bradford Tramways Committees with respect to revising the fares between Leeds and Bradford.

At the City Council on Tuesday, Ald. Tetley said there had been spent this year on tramway works in various parts of the city £41,200 on repairs and renewals, and they hoped to include in the estimates for 1911-12 the sum of £42,906 for various other tramway works. Since 1902 they would have spent by the end of next month £270,500 on repairs and renewals, showing they were in no way neglecting their duties.

London.—At a special meeting on February 2nd the Central London shareholders approved the Bill which is to empower the company to construct a line from Shepherd's Bush to the G.W. Ealing station, and to run their trains to West Ealing. The chairman stated that the G.W. Railway Co. had agreed to erect power plant at West Ealing, and that the cost to the Central London Co. would be from £100,000 to £120,000.

The L.C.C. Highways Committee has decided that the working of the Liverpool Road horse tramways shall be discontinued, and that the lines shall be removed. Apart from interest, &c., a working loss of £1,800 per annum occurs on this route.

Macclesfield.—The T.C., on February 1st, received a report on the scheme proposed by the Railless Electric Traction Co. The Town Development Committee reported that the scheme would tend to develop the town from a commercial and residential point of view, and it was decided to support the passing of the Bill sub-

ject to protective clauses being inserted. The T.C. is to have the option of purchasing the undertaking at the end of 14 years.

Maidstone.—The T.C. has, by 11 votes to 3, rejected a proposal that inquiry be made upon what terms the tramways can be leased for a term of years.

Manchester.—On Sunday a mass meeting was held of delegates from the different branches of the Tramway and Vehicle Workers' Union, to discuss the arbitration offer made by the Tramways Committee with regard to the eight hours question. It was decided that arbitration would only be accepted on the question of the men's right to an eight-hours day without the introduction of other conditions, and a resolution was passed to the effect that in the event of the Tramways Committee refusing to withdraw from the basis of arbitration, which insisted that the arbitrator should consider the question of a reduction of wages in the event of a reduction of hours, a mass meeting of the men must be called to decide what further action, if any, should be taken. In the event of the reply being unfavourable, a mass meeting will probably be arranged for Saturday.

Middlesbrough.—At a special meeting of the T.C. on the 1st inst., it was resolved to lodge a petition against the Middlesbrough, Stockton and Thornaby Electric Tramways Bill of 1911.

An extension of time for constructing the tramways between Middlesbrough and Grangetown, *via* North Ormesby and South Bank, has been applied for by the Imperial Tramways Co.

Nelson.—At the monthly meeting of the T.C. it was decided to make application to the B. of T. for consent to the through running of the cars between Nelson Centre and Laneshawbridge and Trawden by the Corporation and the Colne and Trawden Light Railway Co.

The Electricity Department has agreed, at the request of the Burnley Tramways Department, to place a switch at the borough boundary at Brierfield for the interchange of current for tramway purposes in any emergency. The Burnley Corporation supplies its own energy through Brierfield, but in Nelson it obtains the supply from that authority.

Nottingham.—At a meeting of the City Council on Monday, the chairman of the Tramways Committee, replying to a series of questions, said the amount standing to the credit of reserve and renewals fund account at the end of the last financial year was £62,256. The average annual amount placed to that account for eight years previous to the financial year ended March, 1909, was £6,765. If the average amount which was placed to that account up to March 31st, 1908, had been maintained during the last two years, and was maintained during the next seven years, the amount of the fund at the end of that period would be £102,839, exclusive of interest. The average annual amount placed to the account during the last two years was £1,336. The amount standing to the credit of the account would have been £75,684 at the end of 1910, if the average annual amount for 10 years brought from net revenue account had been at the same rate as the average for the last two years, and having regard to accruing interest and interest on investments. The statement attributed to him in the report of a speech he made on February 1st, viz., "In the next seven years, we should want at least £120,000 to replace the Basford, Sherwood and Trent Bridge lines . . . . or lives would be sacrificed," created a wrong impression. If the whole speech had been reported, a different complexion would have been put upon the statement. The Tramways Committee proposed bringing into operation 1½d. stages, promised in November last, at the commencement of the next financial year, April 1st.

Portrush.—On the 27th ult., Mr. J. H. Swiney, M.Inst.C.E., at the direction of the Commissioners of Public Works, conducted a public inquiry concerning the merits, from an engineering point of view, of the proposed extension of the Giant's Causeway electric tramway. After a good deal of evidence had been heard in favour of, and some against, the scheme, the inquiry terminated.

Rochdale.—The T.C. has decided to apply to the L.G.B. for a loan of £6,000 for road widening, preparatory to the extension of the tramways to Milnrow.

Runcorn.—The clerk to the U.D.C. has been requested to obtain particulars of the scheme under which St. Helens Corporation proposes to run motor-'buses, not only in its own borough but within six miles from its southern boundary, which includes Runcorn.

Scarborough.—The action of a section of the ratepayers who have endeavoured to get the Tramway Co. to run the cars has resulted in which promises to be a reasonable compromise. It will be recalled that the B. of T. was appealed to, and ordered the cars to be run, and the company replied that it could not afford to run them through the winter. Police Court proceedings followed, and the matter was put into the hands of a receiver. If the company failed to run for three months, it is stated it would lose its right, but it has obviated this by running for one day. A memorial has been presented to the Town Council by ratepayers affected, asking that the company be dealt with reasonably and in such a manner as to secure a service of cars.

Torquay.—The extension of the tramways from Torquay to Paignton is likely to be an accomplished fact before many months. It is understood that the tramway company has raised £60,000 for the purpose of extending the tramway from Torquay Station to Paignton, and for carrying out the alterations in connection with the conversion of the system at Torquay. The work of extending the line will be commenced almost immediately, and will probably be completed by the end of May. The work of erecting the overhead system at Torquay has been started at St. Marychurch.

U.S.A.—Detroit Tunnel.—On September 18th last the Michigan Central Railroad commenced running freight trains through the Detroit River Tunnel, connecting Detroit, Michigan, and Windsor, Ontario. Within the month the whole of the traffic, both passenger and goods, was diverted from the car ferries, which stopped running, to the tunnel. The latter, according to the *Railway Electrical Engineer*, cuts off more than half an hour from the timing of fast trains, and from three to 12 hours in the case of through freight; it has also reduced the cost of handling the traffic by at least 75 per cent. The river portion of the tunnel, which is in duplicate, was built up in sections and sunk into position on a prepared bed in the river, being subsequently bolted up. The line is operated on the third-rail system at 650 volts, direct current, by means of eight-wheeled locomotives, each axle being gear-driven by a 300-H.P. commutating-pole motor. The specified tractive effort of each locomotive is 36,000 lb. at 12 miles an hour, but the motors provide for an instantaneous tractive effort of over 50,000 lb. and a maximum speed of 35 miles per hour. The Sprague-G.E. multiple-unit control is fitted, and two or three locomotives are coupled if necessary. Energy for operating the line is purchased from the Detroit Edison Co., and delivered as 4,400-volt three-phase current to a sub-station on the Detroit side. The contract gives a low price, but stipulates that the load must be practically constant within certain limits, and this condition is obtained by the use of a storage battery and booster combination, in conjunction with motor-generators. The battery consists of 312 cells, and will ultimately give up to 11,000-ampere brief discharges; a motor-driven booster, an exciter set for the booster, and a small rectifier set for regulating purposes, to compensate for the varying power factor on the incoming supply, are installed. The total length of electrically operated line is about 6 miles—or 19 miles of single track; 10 electrically-driven pumps are installed to keep the tunnel dry.

Boston.—The joint board of the Transit Commission of Boston and the State Railroad Commission has submitted a report favouring the construction of two tunnels at Boston at a cost of $6,100,000.

The Boston Elevated Railway Co. is obtaining 50 new pay-as-you-enter cars for its surface lines; these will be of the semi-convertible type similar to 191 at present in use.

New York.—During 1910 the street and electric railways of Greater New York carried 1,530,000,000 passengers, giving a revenue of 80 million dollars. This represents an increase of 400 million passengers as compared with five years ago, and means an average expenditure of $16 for each Greater New Yorker, exclusive of steam railway and ferry fares.—*Electric Traction Weekly.*

Westhoughton.—At the meeting of the U.D.C., held on Monday night, it was announced that the clerk to the County Council had been asked to call a conference of all authorities through whose districts the lines of the South Lancs. Tramways pass, or are proposing to pass. The clerk was instructed to write to the Lancashire Electric Power Co., calling its attention to the South Lancashire Tramways Bill for 1911, and asking if the company is likely to oppose the Bill.

Wrexham.—The T.C. has revised the charges for energy to the Tramway Co. as follows, as from September 3rd, 1910: A minimum annual payment for energy up to 150,000 units per annum of £1,015 12s. 6d., against £1,250; for energy over 150,000 units up to 200,000, 1·475d. per unit, against 1·8d.; from 200,000 to 300,000, 1·325d.; from 300,000 to 400,000, 1·175d.; over 400,000, 1d.

TELEGRAPH and TELEPHONE NOTES.

Argentina.—The Department of the Interior has obtained a Supplementary Credit of 495,000 pesos currency (about £43,000) for the purpose of constructing new telegraph lines and erecting extra wires in various parts of the Republic.—*Board of Trade Journal.*

Australia.—The Austrian Ministry of Trade has forwarded a circular to the Chamber of Commerce of the Empire inquiring what reception is likely to be accorded by the public who might be interested, to the installation of printing telegraph apparatus. In the event of an encouraging response, the Government is prepared to set up trial stations in Vienna, Prague and Trieste. Should a minimum of 100 applicants be forthcoming in Vienna, the yearly subscription will be fixed at 600 kronen each, the period of subscription being 10 years.—*Der Elektrotechniker.*

Brazil.—The Ministry of Communications and Public Works has been authorised to expend up to 14,343,935 milreis (currency) and 481.111 milreis (gold) in respect of the Telegraph Department: this will include the erection of new telegraph lines and of wireless telegraph stations.—*Board of Trade Journal.*

Germany.—As the storm warnings transmitted by the German marine station at Hamburg to the coast signal stations and the harbour authorities and made known to shipping by the hoisting of signals only partly fulfil their object, as they are not observable by ships on the high seas, it has been decided to impress wireless telegraphy generally into this service. The coast station at Norddeich has been ordered to circulate storm warnings, and twice daily short weather reports, over the North Sea and the western part of the Baltic. As, however, the smaller fishing craft, for whose benefit these warnings are specially intended, are not provided with wireless apparatus, shipping receiving these warnings and reports by means of their wireless equipment are required to communicate them to neighbouring ships by optical signals. The German mercantile marine have been specially instructed by their shipping organisation to this end. Ships of the Imperial Navy are likewise called upon to render similar services.—*Zeitschrift für Schwachstromtechnik.*

The Bavarian Meteorological Central Station has caused experiments in wireless telegraphy to be made at the Observatory on the summit of the Zugspitze. It was found that not only could signals be received from other stations, but also telegrams could be transmitted to the coast station at Norddeich, whence the exact occurrence of 12 o'clock Greenwich time could be obtained from the shipping on the Atlantic Ocean. In consequence, it has been decided to set up a permanent fully-equipped station on the Zugspitze, which is expected to be in full working order by June next.—*Der Elektrotechniker.*

United States.—At the beginning of 1910 the United States, where there is no State telephone monopoly, had 7,000,000 telephones with a population of 80,000,000, or 87 telephones per 1,000 inhabitants, while the whole of Europe, in which State monopolies are the rule, only had 2,584,000 telephones with a population of 400,000,000, or 6·4 telephones per 1,000 inhabitants.—*Financial News.*

Uruguay.—The Republic of Uruguay has placed a contract with the Berlin Telefunken Gesellschaft for the supply and erection of 17 wireless stations within its territory. A large station for public use will be set up at Monte Video, and medium-sized stations for public use at Paso de los Toros in Riviera, on the Lobos Island and in Banco Ingles. Three stations are to be set apart for naval purposes and six portable stations for the service of the army. The Monte Video station will have a radius of 2,000 km., and was expected to be finished by the end of last year. —*Der Elektrotechniker.*

Wireless Telegraphy.—In a note presented to the Académie des Sciences, quoted in *Le Génie Civil*, M. A. Senouque describes the experiments made by M. Maurice Farman on wireless communication with aeroplanes. A 10-cm. spark coil fed by four accumulators was used, and one of the poles of the transmitter was connected to the metallic framework of the aeroplane, the other being joined to an antenna of two 0·4-mm. copper wires 50 m. long, trailed behind the aeroplane. In flight these wires assume an almost horizontal position. The whole apparatus weighed about 20 kg. Signals were sent from the aeroplane to a distance of 12 km. without any difficulty.

Much interest has been aroused in Germany by a demonstration before the Emperor of a new transmitting apparatus invented by Herr Goldschmidt, using electric waves generated directly by an alternator.

The *Daily Mail* has received information that Prof. Albin Belar, who directs the Laibach Observatory in Austria, has succeeded in constructing a very cheap and handy pocket apparatus which can very quickly be erected in any place to serve as a wireless receiving station.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—March 7th. Eleven sections of a branching multiple magneto lamp-signalling switchboard, for the P.M.G.'s Department in Victoria. See "Official Notices" December 16th.

March 14th.—Installation of wireless telegraphy at Thursday Island and Papua, for the P.M.G. of Australia. See "Official Notices" December 23rd.

April 18th.—One common-battery switchboard, for the P.M.G.'s Department in Western Australia. See "Official Notices" Dec. 23rd.

February 21st.—29 miles of telegraph cable, for P.M.G.'s Department, Victoria. See "Official Notices" January 6th.

February 28th.—One petrol-driven portable winch, for P.M.G.'s Department, Victoria. See "Official Notices" January 6th.

February 28th.—Motor-generator and accumulators, for the P.M.G.'s Department in Victoria. See "Official Notices" Jan. 13th.

March 7th.—10,000 telephone protectors, for the P.M.G.'s Department in Victoria. See "Official Notices" January 13th.

March 8th.—Measuring instruments for the P.M.G.'s Department in Queensland. See "Official Notices" January 20th.

April 4th.—10¾ miles of lead-covered cable, for the P.M.G.'s Department in Victoria. See "Official Notices" February 3rd.

June 14th.—Switchboard, common-battery, multiple, for the P.M.G.'s Department in South Australia. See "Official Notices" February 3rd.

June 14th.—Branching multiple magneto lamp-signalling switchboard, for the P.M.G.'s Department in Victoria. See "Official Notices" February 3rd.

Barnes.—February 13th. Straight-tube water-tube boiler fitted for machine stoking, 600-750-KW. steam dynamo, surface condenser, motor-driven air and circulating pumps, river work and piping, for the U.D.C. See "Official Notices" Jan. 13th.

Beckenham.—February 13th. House cut-outs and service boxes, for the U.D.C.; F. Stevens, Clerk.

Belfast.—February 27th. (*a*) Stores for a year, and (*b*) vulcanised bitumen cables for a year, for the Corporation Electricity Department. See "Official Notices" to-day.

Blackburn.—February 13th. Stores, for the Corporation Electricity and Tramways Department. See "Official Notices" January 27th.

The T.C. has decided to obtain a grease-separator plant and a lathe for the electricity works.

Bournemouth.—February 13th. Stores for a year, for the tramways department, for the T.C. Chas. W. Hill, general manager, Lansdowne (returnable deposit of 5s. for each of the 10 sections).

Brazil.—February 23rd. The Brazilian Ministry of Communications and Public Works in Rio de Janeiro is inviting tenders for the concession for the establishment and working of a telephone line between Rio de Janeiro and the capital of the State of St. Paul.

Croydon.—February 27th. Electric light sundries, &c., for the Mental Hospital, Warlingham, for the T.C., for a year; Clerk of the Hospital.

March 6th.—Fuse and other boxes, meters, &c., lamp-posts and bracket arms, and feeder pillars, for the Borough Electricity Department. See "Official Notices" to-day.

Dublin.—March 6th. 3,000-KW. turbo-alternator, condensing plant, boilers, stokers, steel chimney, pumps, piping, &c., for the Corporation. See "Official Notices" to-day.

Eccles.—The T.C. has decided to invite tenders for the provision and installation of a 500-KW. steam engine and A.C. generator.

Gloucester.—February 21st. (*a*) One 750-KW. D.C. high-speed turbo-generator, with condensing plant; (*b*) one 150-KW. motor-generator, with starting gear; (*c*) switchgear for (*a*) and (*b*), for the City Electricity Department. See "Official Notices" February 3rd.

Greenock.—Tenders are being asked for in connection with the extension to the Greenock T.C.'s generating station at Dellingburn Street.

Grimsby.—February 20th. Continuous-current motors and starting panels, from ¼ to 15 H.P., for the Corporation Electricity Department. See "Official Notices" to-day.

Hull.—February 16th. Electric light installation, fittings and fans, at Sidmouth Street School, for the Education Committee of the T.C.; J. H. Hirst, City Architect, Town Hall.

Ipswich.—February 18th. Rubber-insulated wires for a year, for the Corporation Electricity Department. See "Official Notices" to-day.

Leeds.—February 16th and 21st. (*a*) 1,500 alternating-current watt-hour meters; (*b*) coal and stores, for the City Electric Lighting Department. See "Official Notices" January 20th.

February 16th.—Coal and various materials, for the Corporation Tramways Committee; J. B. Hamilton, General Manager.

London.—ISLINGTON.—February 23rd. Electrical and engineers' stores, for the B.C. See "Official Notices" January 13th.

BERMONDSEY.—February 20th. Stores, for the borough electricity and destructor works. See "Official Notices" February 3rd.

BATTERSEA.—February 14th. Stores for a year, for the B.C. Electricity Department. See "Official Notices" February 3rd.

HAMMERSMITH.—February 15th. Stores for a year, for the B.C. Electricity Department. See "Official Notices" February 3rd.

Manchester.—February 21st. Steel girder tramway rails, fishplates, bolts and nuts, and tie-bars, for the T.C.; J. M. M'Elroy, General Manager of the Tramways, 55, Piccadilly (returnable deposit of £1 1s.).

February 27th.—General stores, for the Corporation Tramways Department. See "Official Notices" to-day.

Newport (Mon.).—March 7th. Electric light fittings, for the B. of G.; A. H. Rees, Clerk, Queen's Hill.

Portsmouth.—February 21st. Supplies, for a year, for the Corporation Tramways Committee. See "Official Notices" to-day.

Sale.—Supply of switchboard and crane, for the U.D.C. Specifications from Mr. Charles Hopkinson, M.I.C.E., 29, Princess Street, Manchester.

Salford.—February 13th. Stores for a year, for the Corporation Electricity Department. See "Official Notices" January 20th.

Turton.—February 20th. Bare copper overhead mains, poles, &c., for electric lighting in Bromley Cross area and Bradshaw Road, &c., for the U.D.C. See "Official Notices" January 20th.

Wakefield.—February 14th. 800-KW. steam alternator, for the Corporation Electricity Department. See "Official Notices" January 20th.

Walthamstow.—February 24th. Stores for a year, for the U.D.C. Electricity and Tramways Departments. See "Official Notices" February 3rd.

CLOSED.

Aberdeen.—The offer of the British Insulated and Helsby Cables, Ltd., for the supply of cables for the year, has been accepted by the Electricity Committee.

Blackpool.—Mr. George Morrison, of Blackpool, has secured the contract for the electrical work for the new Grundy Art Gallery.

Bolton.—The Tramways Committee has accepted the tender of Milnes, Voss & Co. for supplying 10 top covers for single-truck cars.

Devizes.—The following, we are informed, is a list of tenders received for the Wilts County Asylum, Devizes:—

Drake & Gorham	£423	Randell & Sons	£389
Blackburn, Starling & Co.	294	Electrical Contracts and Maintenance Co., Ltd.	235
King, Mendham & Co.	281	**Gent & Co., Ltd.** (accepted)	223
Louis Howell	287		
R. Kerr, Sell & Sons	250		

Grimsby.—The T.C. has accepted the tender of Mr. D. J. Dolby, at £39 15s., for alterations to electric fittings at the Town Hall.

Glasgow.—The T.C.'s Committee has recommended acceptance of the following offers:—

Trolley wire.—National Conduit Cable Co., Ltd.
V. I. R. cables.—W. T. Henley's Telegraph Works Co., Ltd.

Horsham.—We are informed that the U.D.C. contract for electricity meters for all sizes except 5-ampere capacity, has been placed with the Electrical Apparatus Co., Ltd.

Leyton.—The U.D.C. has accepted the tender of Messrs. Willans & Robinson, Ltd., at £6,397, for the supply of a mixed-pressure turbine, generators, condensing plant, and accessories.

London.—L.C.C.—The Highways Committee received a number of tenders from selected firms for the construction of switch galleries at the Camberwell and New Cross sub-stations, and has accepted that of Messrs. Geo. Munday & Sons, at £687.

For the overhead electrical equipment of the Old Kent Road stores depôt, the tenders received were:—

Johnson & Phillips, Ltd.	(accepted)	£220
H. E. Taylor & Co.		248
Clough, Smith & Co., Ltd.		265
Dick, Kerr & Co., Ltd.		274
E. Lawrance & Sons, Ltd.		340

For a 3-cwt. belt-driven pneumatic-power hammer, at 23, Belvedere Road, the tenders were:—

Buck & Hickman, Ltd.	(accepted)	£136
B. & S. Massey		140 (less 2½ %)
Ingersoll Rand Co.		140
Globe Pneumatic Engineering Co., Ltd.		150 (less 2½ %)
Thwaites Bros., Ltd.		160

ISLINGTON.—The B.C. received eight tenders for new main switchgear, and has accepted the lowest received, that of the British Westinghouse Electrical and Mfg. Co., Ltd., at £3,702.

Mardy.—At a shareholders' meeting of the Mardy Electric Supply Co., Ltd., last week, it was decided to install a new motor-generator, booster set, and switchboard. The G.E. Co., Ltd., secured the contract for the entire new plant.

Mexico.—Messrs. S. Pearson & Son's successors, of Mexico, have just placed an important order for the delivery of six water turbines, of 9,700 H.P. each, with Messrs. Escher, Wyss and Co., of Zurich, Switzerland. The turbines are destined for the Santa Rosalia power plant of the first-named firm on the Conchos River, and are of the double Francis type, designed for working under a head of about 160 ft. with a speed of 360 R.P.M., and will be fitted with Escher, Wyss & Co.'s latest designed oil-pressure governors. The order further comprises two 450-H.P. exciter turbines with governors.

Morley.—The tenders of Messrs. Alex. Stark & Son, Ltd., of Glasgow, for the construction of the permanent-way of new lines from the Leeds city boundary at Churwell to the Fountain Inn, Queen Street, Morley, for the sum of £13,631; and of Messrs. Clough, Smith & Co., of London, for the construction of electrical equipment, at £2,341, have been accepted.

Nelson.—The T.C. has accepted the tender of the United Electric Car Co., Ltd., Preston, for brakes for cars.

Rochdale.—The Tramways Committee has accepted the tender of Messrs. Wm. Underwood & Co., of Dukinfield, for laying a further section of the Whitworth tramway extension from the Red Lion, Shawforth.

Rotherham.—The T.C. has provisionally accepted the tenders of the following for additional plant for the generating station:—

Callender's Cable and Construction Co., Ltd.—High-tension feeders, £4,657.
British Westinghouse Manufacturing Co., Ltd.—Rotary converter, £2,258.

Sheffield.—The T.C. has authorised the Stirling Boiler Co. to sub-let parts of their contract for new boilers and accessories for the Neepsend power house to the following:—D. Colville and Sons, Ltd., boiler plates; British Mannesman Tube Co., boiler tubes; J. Ferguson, superheaters; Babcock & Wilcox, Ltd., stokers; David Brown & Co., reduction gear; J. Hopkinson & Co., Ltd., Dewrance and Co., Lister & Co., Schäffer & Budenberg, mountings, fittings and valves; Hohmann & Maurier, thermometers: E. Green & Sons, economisers; J. P. Hall & Sons, feed pumps; Davidson & Co., induced draught fan; Ashmore, Benson, Pease & Co., Ltd., boiler chimneys; Broadhead, Snow & Co., boiler pipe covering; Accrington Brick & Tile Co., fire-bricks; British Purimachos Cement Co., cement; Corporation Wiring and Fittings Department, electric motors. The Council has also given permission to Gilbert Heathcote and Co. to sub-let their contract for constructional ironwork and roof principals respectively for the Neepsend power house extension to the following:—Cargo Fleet Iron Co., Ltd., Frodingham Iron and Steel Co., Ltd., Earl of Dudley's Round Oak Works, Ltd., sectional material; Consett Iron Co., Ltd., and the Parkgate Iron and Steel Co., Ltd., plates.

Warrington.—The T.C. has accepted the following tenders:—

British Insulated and Helsby Cables, Ltd.—Cables, £428.
Edgar Allen & Co., Ltd.—Steel points and crossings for tramways, £359.
F. Warburton.—Construction of a sump-hole at electricity station, £70.

Watford.—The Hertfordshire County Council has accepted the tender of Dick, Kerr & Co., Ltd., for the construction of a tramway from the car station to Queen's Road, Watford, on a schedule of prices, the total not to exceed £14,000.

FORTHCOMING EVENTS.

Institution of Electrical Engineers (Yorkshire Local Section).—Friday, February 10th. At 6.30 p.m. At the Hotel Metropole, Leeds. Annual dinner.

Wednesday, February 15th. At 7 p.m. At the University, Leeds. Paper on "Modern Long-Distance Transmission of Electrical Energy," by Mr. W. T. Taylor (to be read by Mr. J. F. C. Snell).

Manchester Association of Engineers.—Friday, February 10th. 55th anniversary dinner.

Physical Society.—Friday, February 10th. At 8 p.m. At the Imperial College of Science, South Kensington. Annual general meeting. Presidential address on "The Caloric Theory of Heat and Carnot's Principle," by Prof. H. L. Callendar.

Institution of Electrical Engineers (Glasgow Local Section).—Saturday, February 11th. At the Grosvenor, Glasgow. Annual smoking concert.

Tuesday, February 14th. At 8 p.m. At 207, Bath Street, Glasgow. Paper on "Some Considerations relating to the Parallel Working of Alternators" (by the late Mr. J. R. Barr), to be introduced by Prof. G. Baily.

Junior Institution of Engineers.—Saturday, February 11th. At 6.30 p.m. At the Hotel Cecil. Annual dinner.

North-East Coast Institution of Engineers and Shipbuilders.—Saturday, February 11th. At the Wood Memorial Hall, Newcastle. Discussion on papers on "The Holmes-Alderson Automatic Firedamp Cut-out," and "Electric Winding, with special reference to its Development in Upper Silesia." Paper on "The Electrification of the Underground Machinery at Trimdon Grange Colliery," by Mr. S. Tate.

Institution of Mechanical Engineers.—Monday, February 13th. At 8 p.m. Graduates' lecture on "Wireless Telegraphy," by Capt. H. Riall Sankey.

Friday, February 17th. At 8 p.m. Further discussion on Messrs. W. Dixon and G. H. Baxter's paper on "Modern Electrical Dock Equipment."

National Electrical Manufacturers' Association (Incorporated).—Tuesday, February 14th. At 2.30 p.m. At Balfour House, E.C. Committee Meeting.

Institution of Electrical Engineers (Manchester Local Section).—Tuesday, February 14th. At 7.30 p.m. At the University, Manchester. Paper on "Chemical Action in the Windings of High-Voltage Machines," by Messrs. A. P. M. Fleming and R. Johnson.

Institution of Civil Engineers.—Tuesday, February 14th. At 8 p.m. Further discussion on Mr. W. J. Wilgus's paper on "The Detroit River Tunnel, between Detroit, Michigan and Windsor, Canada."

Friday, February 17th.—At 8 p.m. Students' meeting. Lecture on "The Uses of Chemistry in Engineering," by Mr. J. Swinburne.

Institution of Electrical Engineers (Students' Section).—Wednesday, February 15th. At 7.45 p.m. Paper on "Manufacture of Dry-core Telephone Cables," by Mr. H. C. May.

Saturday, February 18th. At 7 for 7.30 p.m. At the Trocadero Restaurant. Annual dinner of the Students' section.

Illuminating Engineering Society.—Thursday, February 16th. At 8 p.m. At the Royal Society of Arts. Discussion on "School Lighting," to be opened by Dr. J. Kerr and Dr. N. Bishop Harman.

Institution of Electrical Engineers (Newcastle Local Section).—Friday, February 17th. At Tilley's. Annual dinner.

NOTES.

London Electrical Engineers.—The Corps of London Electrical Engineers has recently formed a social club to superintend the lighter, but not the least important, side of their work. This club gave a very successful Bohemian concert at Caxton Hall on Saturday, February 4th. Lieut.-Col. H. M. Leaf was in the chair, and was supported by Col. L. Jackson, C.M.G., R.E., Chief Engineer London district, Major W. H. Rotheram, R.E., Major E. C. Seaman, R.E., and Mr. W. M. Mordey, past-president of the Institution of Electrical Engineers. Those present also included Major A. E. Le Rossignol, president of the Club Committee, Major J. H. P. Phillips, and Capt. P. H. Campbell, R.E., Adjutant of the Corps, as well as numerous officers and men of the Corps, with many ladies. Just before the interval Col. Jackson presented the inter-company challenge cups for technical work, drill, shooting and sports, while he also gave Territorial Efficiency medals to Col.-Sergt. M. Mathews and Sergt. Wallis. The next function organised by this Club will be a dance. Arrangements are being made for this to take place at Caxton Hall on Saturday, March 4th.

Copper.—Messrs. Merton's circular of statistics for January, 1911, shows a remarkably small withdrawal from visible supplies, viz., 604 tons. The total withdrawal from English stocks, however, is 1.545 tons, the appreciation being in stocks at Havre, 816 tons, and afloat from Australia, 125 tons increase. The Rotterdam stocks, at 7.600 tons, have increased 800 tons, while those at Hamburg are estimated at the same, viz., 15,000 tons.

Supplies from N. America to Europe are much brisker, and exceed the average (29,581 tons, average 24,600); Spain has sent about average; Chile shipments are lower (2,400 against 2,900); Australian are just below the average. Deliveries are fairly strong at 42,390 tons, the highest for the past 12 months being 45,987 tons in September.

The stock in American producers' hands is given at 54,478 tons (end of December). This shows a reduction of 3,732 tons since November 30th, the average monthly reduction during the past six months being 3,600 tons.

Admiralty Electrical Engineers' Dinner.—The second annual dinner of the London and overseeing staff of the superintending electrical engineers' branch of the Admiralty took place at the Holborn Restaurant on Saturday, January 28th, and was presided over by Mr. C. H. Wordingham, M.Inst.C.E., the superintending electrical engineer. The toast of "The Chairman," proposed by Mr. Edge, was received with acclamation and drunk with musical honours. The Chairman, in his reply, paid a high tribute to his staff generally, and spoke in appreciative terms of the efforts of manufacturers to comply with the exacting conditions of naval service. A very varied musical programme was brought to a close by the singing of "Auld Lang Syne." The accompanists were Messrs. Hulson and Martin, and the general arrangements were carried out by a committee composed of Messrs. Edge, Broomfield, Izzard, and Rogers, to whom a hearty vote of thanks was accorded.

Eccles Electricity Works Salaries.—The Electricity Supply Committee of Eccles T.C. has decided to appoint Mr. F. A. Squire, of Portsmouth, as shift engineer (in the place of Mr. J. S. Hasdell, resigned), at a salary of 30s. per week, rising to 35s. at the expiration of six months' service. The Committee is to grant the following increases of wages:—Mr. W. Ashton, mains foreman, 50s. to 55s. per week; Mr. E. J. Gilbert, station superintendent, 50s. to 55s. per week; Messrs. G. W. Leeder and W. J. Appleby, switchboard attendants, 15s. to 17s. 6d. per week; Mr. E. J. Ward, shift engineer, 38s. to 40s. per week; Mr. C. W. Marsland, shift engineer, 35s. to 37s. 6d. per week, and in April, 1912, 40s. per week; Mr. F. Clark, senior clerk, 32s. to 35s. per week, rising subsequently by annual increments of 2s. 6d. per week to 40s. On application the Council has decided to vary the resolution of February 2nd, 1910, with regard to the salary of Mr. A. M. Mulliner, assistant borough electrical engineer, and to increase the same from £135 to £145 per annum, and in April, 1912, to £150 per annum.

A Bermondsey Electrical Appointment. — The Bermondsey Borough Council on Tuesday evening considered a recommendation of the Electricity Committee, that Mr. C. J. Oake be promoted to the post of third engineer-in-charge, at a salary of £110 a year, rising by annual increases of £10 to a maximum of £130. Mr. C. J. Oake is the son of Mr. W. J. Oake, a member of the Council, and is at present switchboard attendant, to which post he was appointed in March last at a salary of 38s. a week. When the vacancy for the third engineer occurred, Mr. W. J. Oake, who was then chairman of the Electricity Committee, proposed, as a recommendation of the Committee, that his son should be appointed, but the Council refused to sanction this, and instructed the Committee to advertise in the usual way. In reply, 170 applications were received, and 54 were selected for further consideration. The Committee reported that, "after carefully considering the selected list of the applicants, we do not find that such list contains any candidates who are better qualified to fulfil the duties of the position than Mr. Oake." It, therefore, recommended his promotion.

Alderman Harbord, the chairman of the Committee, in moving the recommendation, said Mr. Oake had been performing the duties of third engineer to the satisfaction of the Committee and the chief engineer since last September.

Mr. E. Stickland proposed that the Committee should submit three suitable candidates to the Council for final selection from those who had replied to the advertisement. He said it was extremely wrong for a chairman of a Committee or a councillor to propose his son for an important post under the Council. No doubt Mr. Oake was a very able young man, but it was strange that out of 170 applicants not one was as competent as Mr. Oake, who would never have been appointed to the job in the first place if his father had not been on the Council. Ratepayers were severely commenting on the fact that the Council was "fathering" an act of jobbery. It was an absolutely wrong principle. What was the good of advertising if the Committee did not even interview any of the applicants?

Mr. E. Franken, in seconding, maintained that no son of a councillor should be employed by the Council.

Mr. A. B. Clarke supported the appointment of Mr. Oake, and said there was no rule against the son of a councillor being appointed. After his experience, if Mr. Oake was not fit for the position he was not fit to be in the employment of the Council.

Mr. W. Saunders protested against a young man being classified as a ne'er-do-well because his father happened to be a member of the Council. He should not be brow-beaten. On one occasion there would have been a serious explosion in Rotherhithe Street if Mr. Oake had not been able to do his duty. He was a young man full of ambition and energy. Other councillors in the room had relations working under the Council. The same could be said of them.

Mr. J. Shearring said Mr. Oake had not been brow-beaten, but he had been pushed forward because he was a councillor's son. When he was appointed switch attendant, one or two of the other candidates had much better qualifications.

Mr. F. E. Eddis said young Mr. Oake was highly qualified for the post.

The Rev. Kaye Dunn said the Committee was to blame for any suffering of the father or the son in bringing up this recommendation a second time. This was a matter of public policy. The honour of the Council was at state. If they appointed Mr. Oake they were in danger of being branded as a Council who appointed officers holding high positions from Councillors' sons. They objected to Mr. Oake because he was the son of a man who could speak from the Council chamber. Other similar appointments would follow, and they would soon run the borough by the capable sons of the capable Councillors. It was not a question of the man at all. Even if young Mr. Oake was the best, it would be a wrong appointment; it would be most uncomfortable for the chief of any department to think that one of his subordinates had the private ear of a Councillor.

Alderman Wills said the manner in which the appointment had been proposed was abominable. Only six members of the Committee were present, and they came to the conclusion that Mr. Oake was the best man, in 35 minutes. In that short time they had considered 54 applications.

Alderman Harbord said that on a previous occasion the Committee had spent three hours in going through the applications.

Alderman Wills: That was when you selected 54 out of the 170? Not this last time?

Mr. J. Bustin said it would be suggested in future years that young Mr. Oake got the appointment by jobbery, and it might be known of him that he was shoved through by more or less disreputable means.

Alderman Harbord, in reply, said the only objection to Mr. Oake was that he was the son of his father. The son came forward on his own merits alone, and was worthy and capable of filling the position.

By 24 votes to 15 the Council adopted Mr. Stickland's resolution that the Committee should submit three candidates for the consideration of the Council.

New Petrol-Electric Rail Motor-Car.—The Great Western Railway Co. has entered into an arrangement with the British Thomson-Houston Co., of Rugby, for the construction of a rail motor-car of the petrol-electric type, in which a petrol engine forms the prime mover, but in place of the usual mechanical system of transmission, the power is employed to drive a dynamo, which in turn supplies an electric motor. The design of the car is based on the requirements of branch line working, where a light self-propelled vehicle is required to run under normal conditions, as an independent unit. It is claimed that the petrol-electric system is the most economical form of traction for work of this kind, and hence the new vehicle is to be experimentally tried on the Great Western Railway. It will seat 45 passengers, and be arranged to be driven from either end in the same way as the present steam rail cars. The maximum speed will be 20 miles per hour.

Inquiry.—The makers of a very sensitive "loud-speaking microphone" are asked for.

Tale of a Lamp Standard: How the Press Distorts.—Occasionally in all good humour and much humility we dare to gently draw the kind attention of the Newspaper Press to its display of over-zeal in the cause of gas by ascribing to electricity many a sin of which it is not guilty. Often does it transpire that at least the case is "not proven"; more often is it found that electricity, like Cæsar's wife, is really above even suspicion, and once in a way does it very convincingly befall that gas and gas alone, unaided even by the faintest electric spark, is the great defaulter. To us who have to study newspapers and gas papers and electrical news reports, these are but commonplace remembrances. Even our good humour and humility, however, look strangely like deserting us as we write this paragraph, for we have a more unpleasant duty than usual—is not that kindly enough put under the following circumstances? Here is a daily paper reporting a case of a motorcar's collision with a lamp standard whose light has failed, and persistently failed despite all the gasman's

endeavours. The evidence in the Court was detailed in order that it might be quite understood why the gas had failed to keep alight, and the *Standard* has the absence of mind, the gas-considerateness, to call it an "*electric light* standard," which it was impossible to see "owing to the lamp not having been lighted." It is reported later that an employé of the Borough Council, "on the police having reported that the *electric* standard was not alight," "went to relight it, after removing *an obstruction in the pipe!*" The borough surveyor said he "found that the *electric* standard," &c. So much for the gas *Standard's* report about the *electric* standard that was a *gas* one. What are the facts? We, too, were represented at the Court, and our reporter says :—

For the defence, Fraser, the Council's gas fitter, said the gas had been put out by an accumulation of naphthaline ; he blew down the pipe, the gas came, he lighted it, and went off leaving it alight.

Mr. Newton, borough surveyor, said accumulations of naphthaline in the pipes or joints and cocks stopped the flow of gas. In the past three years the number of lamps in the streets was 4,009, and the total average stoppages were 3,343 per annum, of which 1,872 were due to the presence of naphthaline. When a stoppage occurred, the gasfitter usually knew how to deal with it, and it was an uncommon occurrence, once the naphthaline was blown out, that it should recur so quickly as within a few minutes.

His Honour : In this instance the naphthaline had flowed quicker than the gas.

Witness : Perhaps the stoppage was due to the presence of water.

What we are curious to know is how that gas standard became electrical when it got into the columns of the *Standard*.

Telefunken-Marconi Combine.—The new wireless telegraphy combination, to be known as the "Deutsche Betriebs-Gesellschaft für Drahtlose Telegraphie m.b.H.," started operations on January 15th. It is, says the *E.T.Z.*, the result of an agreement come to between the Berliner Telefunkengesellschaft, the Allgemeine Elektrizitäts-Gesellschaft, the Gesellschaft für Drahtlose Telegraphie System, Prof. Braun, Siemens & Halske and the Compagnie de Telegraphic Saus Fil, of Brussels (the licensees of the German Marconi patents). The fully-paid capital amounts to £45,000, of which the greater part is in German hands.

It is well known that some years ago, owing to the refusal of the Marconi Co. to allow communication between its numerous land stations and ships fitted with other than its own apparatus, a number of ships of the Hamburg-America line and of the Norddeutscher-Lloyd were fitted up with wireless apparatus by the British Marconi Co., and operated directly by its own employés under agreements in force until 1914 in the one case, and 1917 in the other.

The conditions which brought this state of affairs into being ceased, however, in 1907, when the International Convention on Wireless Telegraphy was signed by the representatives of all the leading countries except Italy. By this Convention, free interchange between coast stations and ship installations of whatever type was rendered obligatory. After this date no appreciable extension of Marconi installations on German mercantile ships took place whilst, on the other hand, the Telefunken Gesellschaft received a considerable impetus. This company has since that date fitted up 15 steamers of the Hamburg-America line, 15 of the Norddeutscher-Lloyd, 11 of the Hamburg-South American Line, seven of the Kosmos Line, 12 of the Woermann and German East Africa Lines, and 26 additional steamers belonging to various other German lines. In consequence there are at the present time 38 German steamers fitted with the Marconi system, and 86 with the Telefunken system. None of these installations were the private property of the shipowners, but were entirely under the control of the respective telegraph companies, and were operated by their own employés, the receipts for the telegrams also going to the telegraph companies.

Although an enormous advance in the number of messages handled has taken place since 1908, it has been evident that the competition between the Marconi Co. and the Telefunken Co. has been detrimental to the interests of the shipowners and the general public. The new company is the outcome of the widely expressed desire to overcome these difficulties. The company has, therefore, taken over the whole of the 124 stations on German mercantile ships, together with the operating *personnel* and all obligations and agreements from the Marconi and the Telefunken Companies.

In order to be unhampered technically, the new company has also obtained the right to use all the German wireless patents owned by the component firms.

Lancashire Power Users' Dinner.—The fourth annual dinner of the directors, staff, and consumers of the Lancashire Electric Power Co., and of members of Councils in its area of supply, was recently held in Manchester. Mr. C. D. Taite presided, and there were over 100 guests present. Mr. Young, of Woodhey Printworks, Ramsbottom, in moving "Success to the Company," said that the company's supply was a boon to the many commercial concerns in its area. Mr. Parshall responding, referred to the new weaving shed which was being erected with individual drive at Bradley Fold. Respecting the company, although the days of pioneer work were not fully passed, they had a very hopeful future before them, and a good return possible for the very large amount of money expended in laying the foundations of the company's operations. Mr. Callender proposing "The Health of the Guests," said that his lot had been cast in many lands, and under many conditions, but he always found it best that men who were resorting to new methods should meet together to consider their difficulties and their advantages. Mr. C. H. Pickstone, of Radcliffe, replied for the guests, and in the course of his remarks said that the Lancashire Electric Power Co. had become one of the great forces of Lancashire industrialism, and deserved to reap its full reward. Mr. Whitworth, of Messrs. Frears Lord, said that his firm were erecting the Bradley Fold weaving shed to take 700 looms driven by 700 motors, and they had every confidence in a successful use of electricity for that venture. His son had been in Germany with Mr. Taite to inspect and to inquire into the use which German weavers made of the single-drive feature, and he had returned full of enthusiasm. "Surely what could be done in Germany ought to be done in England" ; but he went further than that, and would say that anything that could be done in textiles in Germany, ought to be done better in England. "The Chairman" was proposed by Mr. Purrett (assistant engineer), and Mr. Taite responded.

Fatalities.—Sheriff Sym (Perth) on Saturday last, held an inquiry regarding the death of James Randall Dale Monro, electrician, of Edinburgh, who died in the infirmary on January 9th last as the result of being severely burned through the bursting of a paraffin lamp.—Archibald McQueen, foreman engineer in the employment of Messrs. Stewart & Becher, electricians, Edinburgh, said he accompanied Monro to Delvine House, Perthshire, for the purpose of overhauling the electric installation there. On arrival they proceeded to the engine house to commence operations—Monro to manipulate the engine and McQueen the other apparatus. There was a paraffin lamp which had to be lit before the engine could be set in motion. Monro took the "blazer" from the engine for the purpose of testing it, and witness saw him light it. He seemed to find some difficulty with it, and McQueen passed the remark that it would perhaps be necessary to procure new washers before the lamp would work properly. The course which Monro adopted was, however, a prudent one, for he was well versed in the use of such lamps, although the one which burst (produced in court) was old-fashioned and out of date now. While Monro was working at the lamp, bending over it, witness heard a shout, and on looking up he saw the whole place was in flames. There were dense volumes of smoke. Monro stood up with his hands in front of his face, and cried out, "Where are you?" Witness got hold of Monro, and threw an overcoat over him. Witness was of opinion that the explosion was caused by a defective burner.—The house surgeon at the infirmary said he was unable to ascertain from deceased how the accident occurred, as the burns around his mouth made it difficult for him to speak. He died from septic poisoning as the result of the burns. A formal verdict was returned.

A correspondent reports that, owing to the breakdown of a mutual arrangement by the respective electricians in the employ of the Liverpool Refrigerating Co. and of Messrs. Cammell, Laird and Co. for switching on the current, there was no electric light sufficiently near a hatchway on a vessel being fitted with machinery at Birkenhead, and in the darkness a youth named Jones fell down the hold and was killed. At the inquest on Friday, February 3rd, a verdict of "Accidental death" was returned, the jury adding that the lighting was insufficient.

Last week an inquest was held into the death of Geo. Edward Griffiths (33), engine driver, who was employed at the Kemberton Colliery. It was shown that deceased, while following his occupation, got into contact with a "live" wire, and was killed. About two hours after deceased commenced working in the pit, the engine stopped, and he was found lying on some wire ropes. Artificial respiration was tried for two hours. The jury returned a verdict of "Accidental death."

Institution and Lecture Notes.—Röntgen Society.—On February 2nd, Prof. Wertheim Salomonson, of Amsterdam, read a paper on the induction coil, recording the results of his oscillographic research upon the behaviour of coils under varying working conditions. His conclusions from the study of the oscillographic tracings were as follows : If the capacity of the primary condenser were varied, the time taken by the primary current to fall to zero also varied. If the capacity were gradually increased, starting from a very small value, the stopping time of the primary current lessened until a definite capacity had been reached. Any further increase of the capacity tended to lengthen the flow of the primary current after the commencement of the break.

Discussing the primary spark, Prof. Salomonson said the energy dissipated in it was only to a small extent taken directly from the battery: The larger part was furnished by the energy stored in the magnetic field of the primary coil. The less the energy expended in this spark, the more would be available at the secondary terminals. The concluding part of this paper was devoted to a discussion as to the number of interruptions per second, which was most advantageous for the secondary effect. His conclusions may be briefly stated, namely, that inasmuch as with very rapid interruptions it was of advantage to reduce their number, and with very slow interruptions, to make them more frequent, there must be some intermediate point which would give the best results from the point of view of the secondary maximum. By mathematical and practical investigation, he believed that for coils of 10 to 12-in. sparking distance the average number of interruptions to be sought was 12 to 13 per second. This number was only possible with very small voltages, say, up to 18 volts. For higher voltages he put forward the empirical rule, that the most advantageous number of interruptions per second, when the time-economy of the interrupter was 0·5, was furnished by the number representing the voltage. This, however, was for small induction coils ; for larger coils the number would be smaller, and with a higher time-economy it would also, of course, be proportionally higher.

On Thursday last week, Prof. Sir Oliver Lodge lectured to a large audience at Birmingham University on the mode of applying electricity at high pressure to agricultural purposes.

A lecture on "Some Little Known Applications of Electricity" was recently delivered by Mr. Sidney H. Hawkins before the members of the Gilfillan Literary Institute, Dundee.

Society of Engineers (Incorporated).—The first ordinary meeting of the present session was held on February 6th, at the Institution of Electrical Engineers. The chair was first occupied by the retiring president, Mr. Diogo A. Symons, who presented the premiums awarded for papers published in the *Journal* during 1910. Mr. Symons then vacated the chair in favour of Mr. F. G. Bloyd, the president for 1911, who delivered his inaugural address, the main portion of which was devoted to a review of the growth of railways in this country since their inception, the legislation which governed their working, and some of the most important details of their construction and equipment as exemplified in modern practice.

Institution of Electrical Engineers' Annual Dinner.—On Thursday last week the annual dinner and reunion of the Institution was held at the Hotel Cecil, and was attended by a large number of members and guests, covers being laid for 400. The President, Mr. S. Z. de Ferranti, occupied the chair, and there were many distinguished men amongst the guests.

After the President had put the loyal toasts, with commendable brevity, Lord Justice Fletcher Moulton proposed "The Institution of Electrical Engineers," of which, he said, though a guest, he was one of the oldest members, and formerly a member of council. He considered that he had lived in the age of electricity; he read Maxwell's famous treatise when it first came out, and remarked that the accomplishment of wireless telegraphy had fulfilled Maxwell's prophecies. Tracing the development of electrical engineering, the speaker said that until 1881, the year of the Paris Exhibition, electricity was regarded as providing the nerves of the community; that year marked its step from the nerves to the muscles, and the last electrical case that he had tried related to the use of electricity for driving rolling mills. It was capable of dealing with the smallest as well as the largest tasks of mankind. Referring humorously in passing to the absurdity of the Daylight Saving Bill, Lord Justice Moulton, in conclusion, expressed his admiration of the President both as a far-seeing engineer and as a man of charming personality.

In his reply, Mr. Ferranti referred to the entry of the Institution into possession of its new home; it was now free to consider other matters, foremost amongst which was the question what it could do to render it more useful to its members individually and for the benefit of electrical science in general. The number and diversity of the electrical interests that the Institution was founded to promote seemed to render it impossible to legislate beneficially for all of them; but in his view there were really *no* divergent interests; progress and prosperity were needed by all, and there was much good work to be done in that direction, for the benefit of all branches of the industry. The present condition of the industry was certainly not satisfactory. Why, in view of the great works that had been accomplished, was it not more prosperous? The railway industry, in spite of opposition, was originated and developed in this country, and the British built the railways of the world, thanks to their early start. In the same way, our textile industries, which were not hampered like some other industries, had flourished, and we supplied the world with textile machinery. The first steam vehicle was built here in 1834, but that industry was killed by the opposition of vested interests, otherwise we might have had the trade of the world in automobiles, whereas it had passed into the hands of Germany and France, from which countries we had imported millions of pounds' worth of road traction machinery, while our own men were unemployed. In the case of electricity, the best work had been done here in the earliest days, but the industry had to face the well-established gas interests, whereas abroad the latter were less firmly entrenched, and electricity consequently flourished there. The "municipal idea" that no one should make a profit had done more mischief than good, and had retarded electrical progress. We should never know how much we had lost from that cause. Electric tramways had been similarly hampered by adverse legislation and unsympathetic municipalities, and their progress in this country had been delayed, while the Continent and the United States got an immense start of us. These were things of the past, but they had left their mark, and were largely responsible for the backwardness of the electrical industry.

We must get to work and see what could be done to repair the damage. Municipality and manufacturer must not be hostile to one another. The impoverishment of an industry led to the result that no money was available for experiments tending towards development and the cheapening of electrical energy. There could be no greater injury thrust upon both buyer and seller of electrical machinery than the idea that we must buy in the cheapest market. Unlimited competition was wrong from every point of view; there should be a competition of excellence only. If we could get more reasonable ideas adopted, and put the electrical industry on a sounder basis, the "all-electric" idea would develop, and that soon, and it would be accompanied by prosperity to the Institution, its members, and the country generally.

Mr. Sam Mavor (Chairman, Glasgow Local Section) proposed "The Guests," and said that the evident desire of the Council to associate the Local Sections with headquarters would be appreciated by the Sections. Mr. L. Stokes, president of the Royal Institute of British Architects, responded briefly, and shortly afterwards the company adjourned, as usual, to the Victoria Hall, where old acquaintances foregathered, and doubtless many new ones were made. This feature of the Institution's programme, in which it differs markedly from most other Societies, is cordially appreciated, and renders the occasion exceptionally popular and enjoyable. During the evening a programme of music was provided by the "Imperial Orchestra."

Appointments Vacant.—Switchboard attendant for the Stretford U.D.C.; improver, for the Perth Corporation electricity works (12s.); shift engineer, for the Dover electricity department (£80); meter repairer and tester, for the Harrow Electric Light and Power Co., Ltd. (30s.); mains superintendent, for the Stoke-on-Trent Corporation; clerk for the Rawtenstall Corporation Tramways Department (20s.); working foreman electrician for the Bristol Docks. See our advertisement pages to-day.

The B.A. Meeting at Portsmouth.—Sir Wm. Ramsay will be president of the meeting opening at Portsmouth on August 30th. Prof. H. H. Turner, D.Sc., F.R.S., will preside over the Mathematical and Physical Science Section, and Prof. J. H. Biles, LL.D., will be president of the Engineering Section.

Tramwaymen's Socials.—The electric tramway employés of Darwen held their annual social on February 2nd. The Blackburn Corporation officials had entire charge of the traffic in both towns—a compliment which Darwen will return later on.

The employés of Blackpool, St. Annes and Lytham Electric Tramways had a whist drive, in aid of their sick club funds, on February 1st. Over 300 persons took part in the drive. Mrs. H. W. Laing, the wife of the general manager, distributed the prizes.

Mersey Railway Rifle Club.—A rifle club has been formed in connection with the Mersey Electric Railway Co., a fine covered range for miniature rifle practice being provided at Birkenhead. Mr. Shaw (general manager of the company) is interesting himself in the movement, which is carried on under the auspices of the Employés' Institute and Athletic Club.

Tramway Workers.—In connection with the Bilston and South Staffordshire Branch of the Amalgamated Association of Tramway and Vehicle Workers, a meeting of members was held on Friday last week at Bilston, under the presidency of Mr. T. R. Peate. Mr. F. Vaughan (secretary) reported that the shedmen of both branches had forwarded an application for an increase of pay for Sunday labour. It was decided to send the application to the general manager of the tramways company for his consideration. It was announced that the tramway men at Stourbridge would hold a meeting soon in order to organise themselves and become members of the branch.

Osram Lamps in Madeira.—Some particulars of the use of these lamps for street lighting in Madeira show that 27 32-watt lamps, burning on direct-current 230-volt circuits, have so far averaged over 3,800 hours each, the limit figures up and down being 4,366 and 3,248 hours respectively.

These uniformly good results have been achieved despite pressure variations of 10 volts due to the old plant in use, and the vibration occasioned through traffic on stony roads. The lamps burn in all sorts of positions, and are fixed either on wall brackets or 10-ft. posts on the kerb.

Holborn Street Lighting.—The official tests of the experimental street electric and gas lighting, shows an average C.P. per lamp for the former of 395, and for the latter of 318. The tender for electric lighting was £6,602, and for gas lighting £7,527 In spite of the saving by electric lighting, the local Highways Committee recommended gas lighting. The Council has, however referred the matter back

The A.E.G. in the Far East.—It is announced in the daily Press that Herr Dernburg, the German ex-Colonial Secretary, who recently joined the board of the A.E.G., will devote himself to the electrification of China and Japan.

The Lightning from Heaven.—The Post Office contract form for telephone subscribers includes the following clause: "The subscriber should indemnify the Postmaster-General against any claim on account of any damage or injury caused by any high-potential current (not emanating from the premises of the Postmaster-General) which may be conveyed to the subscriber's premises by the Exchange line." "High potential current (not emanating from the premises of the Postmaster-General)" seems, says the *Manchester Guardian*, to be the cautious official way of referring to the lightning from heaven.

The foregoing note appeared in the *Westminster Gazette* last week, and no doubt both the writer and the clipper of it felt very well satisfied with their little joke, though the point of it is microscopic. Non-technical journalists, however, would be well advised in handling such points with care, and even in avoiding them altogether, as they are apt to prick their fingers. Our technical readers need no explanation of the allusion contained in the contract form, but, for the benefit of others, we may point out that, to the telephone engineer, all lighting, tramway and power transmission circuits generally, carry "high-potential current," and that special provision has to be made in telephone exchanges to prevent damage to the delicate apparatus from the intrusion of such currents, due to accidental contacts between overhead conductors.

Electric Steel Furnaces.—In a paper read before the Engineers' Society of Western Pennsylvania on November 16th, Mr. P. McNiven Bennie, of Niagara Falls, N.Y., reviewed the history of the development of electric furnaces. He stated that electric furnaces in the United States would produce a total of 125,000 tons of steel during 1910, so that the process could no longer be considered experimental. He claimed that although the electric furnace will not replace the modern open-hearth steel furnace or the Bessemer converter, yet it will become a serious competitor of the present crucible process for making high-grade steel, and will create a new metallurgy which promises to produce vast changes and improvements in steel making.—*Electrical World.*

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The Tonbridge U.D.C. has appointed Mr. E. G. Staygle, assistant engineer at Oban, and formerly of Worthing, as assistant electrical engineer, at a salary of £75 per annum, rising by £5 a year to £100. There were 78 applications. The Council has also appointed, out of over 40 applicants, Mr. Lancaster, of Whitehaven, as shift engineer.

Mr. Herbert Taylor, shift engineer at Accrington electricity works, has resigned.

Mr. D. H. Davies, who is at present engaged as station superintendent at the Darlington Corporation electricity works, has been appointed chief assistant electrical engineer to the Stockton Corporation.

Mr. F. Woods, late shift engineer at the Heston and Isleworth U.D.C. electricity works (not assistant engineer as inadvertently stated by us last week) was presented by the staff with a pair of silver mounted hair brushes on his leaving to take up his appointment with Messrs. Belliss & Morcom. Mr. R. K. Butler has been appointed to the vacant position of shift engineer, and Mr. Jeffrey Blake has been appointed improver. Mr. E. W. James, as Mr. P. E. Rycroft's chief assistant, has occupied that position for some years.

Mr. Savage, electrical engineer, Dudley, is to receive an honorarium of £50 for his services in the arbitration, Corporation *v.* Tramway Co.

The Gloucester Corporation Electricity Works staff have presented a marble clock to Mr. A. Calogreedy, charge engineer, on his marriage; and a kit bag to Mr. Niblett, who is leaving to join the staff of the Kidderminster electric power station.

On Monday last, at All Saints' Church, Hove, Mr. W. S. Watson, shift engineer, Brighton Corporation Electricity Works, was married to Miss T. Vida Ferguson, of Hastings, Neb., U.S.A. The staff and workmen of the electricity works presented him with a set of fish servers, knives and forks.

Mr. Richard Snape, of Rochdale, has been appointed switchboard attendant at Southend Corporation electricity works.

The following appointments have been made for the new electricity and destructor works of the Aberdare U.D.C.:—Clerk, G. G. Morgan, Swansea Electricity Works, 40 applicants; first shift engineer, W. Williams, Aberdare, 40 applicants; second shift engineer, P. L. Jones, Merthyr Tydfil, 50 applicants; third shift engineer, R. J. Davies, Northampton Electric Light Co., 49 applicants; cable jointer, F. Wilson, Bradford, 24 applicants.

The Northampton Town Council has promoted Mr. T. G. Smith, third engineer, to the position of second engineer.

The staff and employés of the Hull Corporation electricity department presented Mr. S. F. Greepe, charge engineer at the Sculcoates Works, with a clock and a pair of candlesticks, on the occasion of his marriage on February 1st.

Tramway Officials.—Mr. J. E. Mallalieu, A.M.I.E.E., late of Messrs. Dick, Kerr & Co., Ltd., has recently been promoted from chief assistant to engineer by the Burma Electric Tramways and Lighting Co., Ltd., Mandalay.

Mr. E. H. Edwards (formerly Mr. J. R. Salter's assistant), has been appointed general manager of the Lancashire United Tramways, Ltd., in place of the late Mr. Salter, whose death was reported in these columns a few weeks ago.

General.—Mr. J. W. Swithenbank has been appointed district manager at Hull for the National Telephone Co.

Mr. A. L. C. Fell, chief officer of the L.C.C. Tramways, is a member of a Departmental Committee appointed by the Home Secretary to investigate the dangers of lead poisoning to those engaged on the painting of carriages and coaches.

Obituary.—We regret to record the death Mr. A. L. Phillips which occurred at Lobito, West Coast of Africa, on December 15th, where he was acting for Messrs. Johnson and Phillips, Ltd., in connection with the erection of an electric power station. Mr. Phillips, who was formerly in the mains department of the Charing Cross and City Electricity Supply Co., joined Messrs. Johnson & Phillips in September last. The cause of his death was appendicitis.

We regret to announce the death of Mr. Francis Nicolas Spon, of the well-known publishing house of E. & F. N. Spon, Ltd., which took place on February 3rd. The deceased gentleman was in his 89th year.

Smithfield Markets Electric Supply Co., Ltd.—For the past year the gross profit was £3,094, against £2,152 in 1909, and the net profit was £1,446 compared with £308; £1,000 is transferred to a sinking fund for redemption of the debenture stock, and £446 is carried forward. Notwithstanding the almost universal use of metallic lamps, the output shows only a small decrease, while the revenue from current increased by £800. In order to improve the position of the company, three new generating sets are to be installed to replace others which are no longer economical.

CITY NOTES.

Bruce Peebles & Co., Ltd.

The report for 1910 shows an adverse balance of £7,275 for the year. Competition has continued acute, prices have ruled low, but an increased volume of work has been obtained, and marked progress has been made. Efforts to extend the organisation, especially with regard to obtaining business abroad, have led to substantial improvement in the present accounts.

Metropolitan District Railway Co.

The report of the directors for the half-year ended December 31st, 1910, which was submitted at the meeting held yesterday (Thursday) states that the expenditure on capital account during the half-year has been £231,883, including £175,061 in part payment of arrears of dividend on guaranteed stock. The traffic and revenue continue to expand. The gross receipts on revenue account were £300,806, an increase of £21,195 on the receipts for the corresponding half of last year. The working expenses were £150,593, a decrease of £2,080. After providing for interest and other charges and setting aside £10,000 as a reserve for renewals, the net revenue account shows a credit balance of £63,022, and the directors recommend that a dividend at the rate of £4 per cent. per annum be declared on the 4 per cent. guaranteed stock, and that a dividend at the rate of £3 10s. per cent. per annum be declared on the 4½ per cent. first preference stock. These dividends will be payable on February 14th.

The following table gives a summary of comparative figures for the second halves of the years 1910 and 1909:—

	Half-year ended Dec., 1910.	Dec., 1909.	Inc. or dec.	Or per cent
Gross revenue	£300,806	£279,611	+£21,195	7·58
Working expenditure	150,593	152,673	—2,080	1·36
Passengers, including workmen & season ticket holders' journeys	36,552,304	33,902,406	+2,649,898	7·82
Passengers at workmen's fares	6,984,060	6,421,158	+562,902	8·77
Passenger receipts	£280,051	£260,767	+19,284	7·40
Average receipt per passenger	1·84d.	1·85d.	+0 01d.	0·54
Train-mileage on District Railway	1,723,881	1,638,100	+85,781	5·24
Car-mileage on District Railway	6,891,374	6,464,555	+426,819	6·60

Good progress has been made by the L. & S.W.R. with the widening works between Studland Road and Acton Lane Junctions, and it is hoped to have the work completed in sufficient time for next winter's traffic. Several of the new carriages (of which 52 have been ordered) have been in service since the end of the year. They are of steel construction and the small amount of timber used has been made fire-resisting by a special treatment. The London Electric Railway Co. are erecting escalators or moving stairways (which work very successfully on several other railways), at Earl's Court Station for the convenience of the Exchange traffic between the District and Piccadilly Railways at this station. Passengers will be transferred between the Low Level and High Level Stations by means of these escalators, and it is expected that additional traffic will result thereby. Extensive improvements have been made at the Mansion House and Putney Bridge Stations, which will materially improve the train working. The deposit on season tickets was abolished from January 1st, 1911. The company have consented to the transfer of the lease of the Earl's Court Exhibition grounds from "The London Exhibitions, Ltd.," to "Earl's Court, Ltd." The grounds will be opened this year as an amusement park. The company are promoting a Bill in Parliament seeking powers to incorporate a Joint Committee of the Metropolitan District Railway and the London Electric Railway Companies, and to empower it to purchase by agreement the generating station of the Underground Electric Railways Co. of London, Ltd., situated at Lots Roads, Chelsea, and to lease it to the two railway companies, and for the supply of electrical energy to certain railways and tramways and authorised undertakers and the companies' tenants, also for the construction of new railways at Earl's Court for the more convenient working of the railway at that important point, and also to authorise the company to use its funds for the purpose of acquiring and working omnibuses, cabs, and other road vehicles.

The electrical energy for working the District and London Electric Railways is obtained from the Lots Road Station under agreements with the Underground Co. for a period of 99 years from 1904. Under the terms of such agreements, the amount paid by each of the companies is based upon the actual cost to the Underground Co. for working the station, plus a small profit, and the interest charges upon the cost of the generating station. The directors consider it highly desirable that the railways should have complete possession of the generating station from which the supply for working the railways is obtained, providing a fair price for its purchase can be agreed upon with the Underground Co. The Joint Committee will be empowered to lease the generating station for a term of 999 years to the two railway companies. The generating station when leased to become a part of the undertaking of the two companies. The Joint Committee will create and issue stock for the purchase of the generating station, to be called "Metropolitan District and London Electric Railways Joint Power House Rent Charge Stock." Each of the two companies will, in the first instance, be liable for a moiety of the rent which will be equivalent to the interest charge upon the stock so created and issued, and the expenses of the Joint Committee. Provision is, however, made for apportioning this amount between the two companies in proportion to the amount of electrical energy used by each company. This charge is to be a working expense of each of the two companies as at present. The purchase and lease of the generating station will not take effect until the purchase price and terms of the lease have been approved at a general meeting of each of the three companies.

A Bill is being promoted in Parliament by the London Electric Railway Co., seeking powers to extend their railway (Charing Cross, Euston and Hampstead line) from its present terminus at Charing Cross to a point beneath this com-

pany's Charing Cross station, and to make an agreement with this company with reference to the construction, working, maintenance and user of the proposed railway, and of any station or works in connection therewith. It is also intended to improve the present interchange arrangements with the Baker Street and Waterloo line, and to provide suitable facilities for interchange traffic with the Hampstead-Highgate line at the Charing Cross station. The traffic between the two railways will be greatly improved and this company will benefit thereby. The agreement to be made between the two companies will provide for contributions towards the interest on the cost of constructing the extension railway. The Bill will be submitted for the approval of the proprietors of this company at the special meeting to be held immediately after the ordinary meeting.

The directors with very great regret report the death of Sir Clifton Robinson, a director. Mr. John Young having retired from the board, Mr. Henry A. Vernet has been elected as a director.

	Passengers.				Receipts.			
Half-year ended—	1st Class.	3rd Class.	Season Tickets (Estimated Journeys.)	Total.	1st Class. £	3rd Class. £	Season Tickets. £	Total. £
June, 1909	1,201,494	28,065,229	3,683,172	32,949,895	17,121	208,449	28,450	254,020
Dec., 1909	1,068,911	29,071,139	3,762,356	33,902,406	15,484	215,960	29,323	260,767
June, 1910	1,165,026	30,340,066	4,675,216	36,180,308	17,250	226,395	36,838	280,483
Dec., 1910	1,044,220	30,949,140	4,558,944	36,552,304	15,981	228,768	35,902	280,051

Train and Car-Mileage, Half-year ended December 31st, 1910.

Train-mileage.	On District Railway. District Co.'s trains.	Other Co.'s trains.	Total.	Total miles run by District trains, including mileage on joint and foreign lines.
Passenger trains—Steam (L. and N.W.)	—	14,824	14,824	—
Passenger trains—Electric ..	1,554,819	152,120	1,706,939	2,298,088
Goods and mineral trains (Midland, &c.)	16	2,102	2,118	33
Total ..	1,554,835	169,046	1,723,881	2,298,121
Electric car-mileage	6,279,819	611,555	6,891,374	9,630,779
Totals Half-Year ended December 31st, 1909.				
Train-mileage	1,479,461	158,639	1,638,100	2,164,212
Electric car-mileage	5,896,804	567,751	6,464,555	9,084,116

Yorkshire Electric Power Co.

The directors' report, to be submitted to the half-yearly meeting at the Hotel Metropole, Leeds, on Tuesday, February 21st, shows a very gratifying improvement. The receipts from the sale of energy and for work charged out to consumers, &c., amount for the 12 months ending December 31st, 1910, to £37,544, against £25,763 for 1909, and £18,643 for 1908. The gross profit on the revenue account for the year 1910 is £11,308, against £6,087 for 1909, and £2,819 for 1908. After payment of mortgage interest, the net revenue account shows a profit on the year 1910 of £6,503, against £2,665 for 1909, and £718 for 1908. The net profit of £6,503, with £3,382 brought forward, makes a total balance of £9,886, and the directors recommend that this amount should be disposed of as follows:—To pay a dividend at the rate of 6 per cent. per annum on the amount paid up on the cumulative preference shares, from the respective dates of payment, amounting to £435, carrying forward £9,450. The additional boiler and the fourth turbine mentioned in the report of February, 1910, have been installed; the boiler has been completed and taken over, the turbine has been erected and will shortly be ready to take over. These additions complete the plant for which the present buildings at Thornhill were originally planned. The Yorkshire Electric Power Act, 1910, received Royal assent on July 26th, and, in accordance with the resolution passed at a special meeting of shareholders held on September 6th, 1910, £100,000 6 per cent. preference shares were offered to the shareholders, to second mortgage holders of the Power Co., to shareholders of Electrical Distribution of Yorkshire, Ltd., and to customers of the two companies. At the date of this report over £58,000 of this issue had been applied for, and as applications continue to be received, the directors anticipate that the whole of the issue of £100,000 will shortly be taken up. The eastern mains to Whitwood, Castleford, and Allerton Bywater were completed early in the year, and extensions are now being made to Ledston and Micklefield. An agreement has been made for bulk supply to the Whitwood Urban District Council, and a supply is being given to Electrical Distribution of Yorkshire, Ltd., for distribution in Castleford. Later in the year the western mains were extended to Southowram, Elland, Greetland, Stainland, Sowerby Bridge and Hipperholme, in the last two of which places Electrical Distribution of Yorkshire, Ltd., has undertaken the distribution. Extensions have also been made to the southern mains from Clayton West to Barugh and Silkstone, and a further extension is now being made to Penistone, where a supply will be given in the course of a few weeks. All these extensions have been made to supply consumers with whom agreements had already been concluded. There has been a steady growth year by year in the use of the company's supply in districts where mains were first laid, and the company is also benefiting by the longer hours worked by old customers owing to improvement of trade. During the past two years the company's mains have been extended into a number of new districts, and the same satisfactory increase of demand is now being experienced over the wider field of operations. Whilst the erection of overhead mains has enabled extensions to be made that are earning a satisfactory revenue, they have considerably increased the payments for rents and wayleaves. The value of the company's supply as an aid and an inducement to the development of new industries in districts in which it is available is becoming more fully appreciated.

London Electric Railway Co.

The directors' report for the half-year ending December 31st, 1910, submitted at the meeting held yesterday, states that the comparative figures for the corresponding half of last year are the figures of the G.N., Piccadilly and Brompton, Baker Street and Waterloo, and the Charing Cross, Euston and Hampstead Railways consolidated. The expenditure on capital account for the half-year (excluding the acquisition of the Baker Street and Waterloo and Charing Cross, Euston, &c., Railways and working stocks) has been £434,113. The item of £400,000 represents the amount of fully-paid ordinary shares issued to the Underground Electric Railways Co. of London, Ltd., under the agreement supplemental to construction contracts made between that company, the Charing Cross, Euston and Hampstead Railway Co., and the G.N., Piccadilly and Brompton Co., in full settlement of the balance of account for extra works. The gross receipts on revenue account amounted to £352,895, being an increase of £6,837 compared with the corresponding half of last year, and the working expenses were £166,968, a decrease of £4,107. After providing for interest and rents, and reserving £7,500 for contingencies and renewals, there remains a balance of £101,454 available for dividends, and the directors recommend that a dividend at the rate of 4 per cent. per annum be declared on the 4 per cent. preference stock, and that a dividend at the rate of ¾ per cent. per annum be declared on the ordinary shares, leaving a balance of £3,475 to be carried forward. The dividends will be payable on February 14th:—

	Half-year, Dec., 1910.	Half-year, Dec., 1909.	Inc.	Dec.	Per cent.
Gross revenue ..	£352,895	£346,058	£6,837	—	+ 1·976
Working expenditure	£166,968	£171,075	—	£4,107	— 2·401
Passenger receipts ..	£332,563	£328,566	£3,997	—	+ 1·216
Train mileage.. ..	2,814,635	2,912,142	—	97,507	— 3·348
Car mileage	8,636,749	8,638,217	—	1,468	— ·017

Half-year ending.	No. of passengers, including season ticket holders.	Receipts.
June, 1909	48,343,830	£338,722
December, 1909	46,763,143	328,566
June, 1910	50,045,140	343,604
December, 1910—London Electric Railway..	*46,665,279	332,563

* On and from July 1st, 1910, a "through" passenger on the company's lines is counted as one "local" passenger, whereas previously a "through" passenger was counted as one passenger on each line used.

The report also contains full references to the escalators at Earl's Court, also to the new Bills relating to the purchase of Lots Road station, and other matters, some of which are mentioned in another column of this issue, in the report of the Metropolitan District Railway.

National Gas Engine Co., Ltd.

The directors report that the net profit for the year ended December 31st, 1910, after providing amply for depreciation of buildings, tools, &c., and allowing for management salaries and income-tax, is £52,806. An interim dividend for the six months to June 30th, amounting to £18,927, being at the rate of 5½ per cent. per annum on the preference shares and 20 per cent. per annum on the ordinary shares, was paid on July 31st 1910, leaving a balance of £33,879, which, added to £9,343 brought forward from last year, makes a total of £43,222 to be dealt with. The directors recommend the payment of a final dividend at the rate of 5½ per cent. per annum on the preference shares and 20 per cent. per annum on the ordinary shares (as regards the partly paid shares, on the amounts paid thereon), both less income-tax, for the six months ended December 31st, 1910. This will absorb £21,398 and leave £21,823, of which the directors propose to place £10,000 to the reserve fund (making it £110,000), £4,000 to a special reserve fund, and to carry forward £7,823. The directors regret to record the death of Mr. Joseph Bickerton. Mr. Richard Bickerton has been elected a director in his place.

Chelsea Electricity Supply Co., Ltd.—The directors recommend a dividend for the half-year to December 31st, 1910, at the rate of 6 per cent. per annum on the ordinary share capital of the company, making 5 per cent. for the year 1910, after paying debenture interest and placing £12,772 to depreciation fund, £704 to debenture premium redemption fund, and writing off £1,089 from the cost of extinction of founders' shares; carrying forward £2,290, as against £1,362 in the previous year, subject to audit. The dividend will be payable on and after March 15th, 1911. The dividend compares with 4½ per cent. for 1909.

Central Electric Supply Co., Ltd.—The directors' report for the year ending December 31st, 1910, states that energy has been supplied to the Westminster Electric Supply Corporation, Ltd., and the St. James' and Pall Mall Electric Light Co., Ltd., throughout the year, to an amount of 18,641,190 units. After making a full allowance for sinking fund and depreciation the net balance for the year 1910 is £4,991 plus £36 brought forward = £5,027. The directors propose to pay a dividend at the rate of 5 per cent. on the ordinary shares for the year absorbing £5,000 and to carry forward £27.

Company Registrations.—According to the *Investors' Guardian*, the capital of the new electrical companies registered in England in 1910 was £2,408,457, as compared with £3,253,920 in the preceding year.

Anglo-American Telegraph Co., Ltd.

THE meeting of this company was held on Friday last at Winchester House, E.C., Mr. F. A. Bevan presiding.

The CHAIRMAN, in moving the adoption of the report (see ELECTRICAL REVIEW, p. 198), said that the total gross receipts for 1910 had been larger than they had ever received since the shilling tariff was adopted, reaching £690,000. They, therefore, had to congratulate the shareholders upon an increase of business during the year, and upon the fact that the directors were proposing a larger dividend than had ever been paid except in 1907, when they had not put, as they had in the past year, £20,000 out of the receipts to the renewals fund. The renewal fund in 1907 was just over one million, the sum which they had agreed to regard as an ideal amount, and therefore they were able in that year to declare an even larger dividend than they could on the present occasion. Under the circumstances, however, and seeing that the Stock Exchange business had not been nearly so good during the past year as in the previous year, he thought the shareholders were to be congratulated upon the development of the general traffic of the company. Looking back upon the whole year, the traffic receipts showed an increase of £14,064, but the receipts for chartering the *Minia* being less than in 1909 by £2,414, the net increase in receipts was £11,550 for the year. The net expenses had been about £2,413 more than in 1909, which increase arose solely through the ordinary increases in salaries, so that the increased revenue available for dividend was £9,464, which enabled them to pay a dividend of £3 15s. per cent. as against £3 12s. 6d. last year, on the ordinary stock, and 30s., as against 25s., on the deferred stock, and to carry forward slightly increased balance. The renewal fund at this time last year was £938,392, and on December 31st last it stood at £981,317, showing an increase of £42,925. He ought to state that in that £981,000 was included the book value of their Stock Exchange securities. They would remember that there was a very large depreciation in those securities, and that they set aside an investment reserve account amounting to £90,000, which they thought would be sufficient to cover all the depreciation, but during the past year he was sorry to say that the securities had depreciated still further by the sum of just over £13,000. They had not dealt with that in any way so that the renewal fund, really if it were taken at its market value, would be £13,000 less than the £981,000. Probably since December 31st, their securities had increased—railway securities, for instance, had gone up—and therefore though he could not tell them the precise amount, he should think that a good deal of that £13,000 was already recovered. In speaking of the renewal fund, it must also be borne in mind that their 1873 cable was still broken. If they had had good enough weather to repair that cable during the past year, they would have had to take more out of the renewal fund. In the spring when they got good weather, no doubt those repairs would be effected, but the cost of the work should really have been thrown upon the past year. Therefore, when speaking of their renewal fund, they had to take those two items into account, the depreciation in securities, and the fact that the 1873 cable was still broken. There had been no particular occurrence during the past year, and with the increase of business, they might look back with satisfaction as far as the past was concerned. There was, however, one matter in the report—the provisional agreement between that company and the Western Union Telegraph Co., as to which shareholders would naturally like to hear something. He wished it had been in his power to inform them that day that subject to the resolution which would have to be passed at a special meeting convened for the purpose to consider the proposed arrangement, the whole matter had been settled. As they would see in the report, certain legal formalities had not yet been got over. He did not want shareholders to attach too much importance to that. He saw in the newspapers that morning that there had been a slight fall in the stock owing to what was called a "hitch" having occurred, but he did not think that was quite a fair way of putting it. The directors hoped and trusted that in a short time, subject to the law's delays, they would be able to get over the difficulties which had occurred. Some of them were of comparatively little importance, and could hardly be called difficulties at all. For instance, they had not the power at the present moment under their memorandum and articles of association to make any such arrangement, but that could be got over by calling a special meeting to alter the articles. There were, however, other matters which could not be disposed of quite so quickly, and he ventured to express the hope that shareholders would not press him or question him too closely upon the matter that day. They were taking the very best legal advice as to how to bring the arrangement to a complete settlement. The basis of the arrangement was that the Western Union Telegraph Co. should give their shareholders a perpetual guarantee of 3½ per cent. upon their seven millions of capital. There had been a suggestion of something less than an absolute guarantee, but the directors believed that nothing short of that absolute guarantee of 3½ per cent. would be really satisfactory. It was also stated in the report that the companies would be distinct. He was not quite sure as yet that that would be carried out, but as he had said, nothing could be settled without the consent of the shareholders. When they had got over the difficulties at present existing, the board would convene a special meeting and lay before the shareholders the agreement arrived at, so that they would lose nothing by going away from that meeting without the intelligence which they naturally desired to obtain, and in the interests of the shareholders themselves he must ask them to kindly refrain from cross-examining him upon the present state of the agreement. He believed it was only a matter of law, and that the legal difficulties would be got over, and therefore there need be no fear in the minds of the shareholders that there was any likelihood or possibility of the arrangement contemplated falling through.

SIR GERALD FITZGERALD, K.C.M.G., seconded the resolution.

Replying to Mr. H. Hills, the CHAIRMAN said that the 1873 cable had been broken since the autumn of last year. It was not altogether an old cable, they had put in new shore ends and a good bit of the middle. The probability was that it was well worth repairing, and he hoped it would continue in operation for many years.

MR. HARDCASTLE said he would not ask the chairman any questions regarding the agreement, as he was sure the shareholders had the utmost confidence in the directors. He ventured, however, to express the hope that it would not be possible to get rid of their present board under any agreement, and a board nominated by the American Telegraph Co. substituted for it. The second point to which he hoped the directors would give special attention was to make it impossible under any future arrangement for the American company to purchase the undertaking and do away with the perpetual lease. That was very important, because in the case of liquidation the "B" shareholders were always to be paid off at four times the price of the "A's." At present they were to receive four times the amount of dividend, and he was confident that as long as they had their own board the "B" shareholders would be treated fairly. He hoped the board would consider this question, too—as to how far the British Government would like to see the cables across the Atlantic in the hands of a foreign power. The Government might decide to buy it up, and that again would involve liquidation.

MR. L. PAYNE said he could not agree with Mr. Hardcastle as to the "B's" being paid off at four times the amount of the "A's" in the event of a sale. The "B" shareholders had always received their dividends but the "A's" had not, and it was the latter shareholders who had built up the reserve fund.

The CHAIRMAN said that all he could say was that the board would bear in mind what had been said by Mr. Hardcastle. They would certainly give his suggestions due consideration, but beyond that they would not expect him to commit himself.

Replying to a vote of thanks for presiding, the CHAIRMAN said that probably at no distant date they would have to ask the shareholders to meet again for the purpose of adopting such means as were necessary for carrying out the proposed agreement.

St. James' and Pall Mall Electric Light Co., Ltd.

THE report of the directors for the year ending December 31st, 1910, states that supply has been distributed on a total connection of 12,999 KW., being an increase of 1,134 KW. For this purpose 9,899,716 units were supplied to consumers. Under powers given by the London Electric Supply Act, 1908, the company, by an agreement with the London Electric Supply Corporation, Ltd., approved by the Board of Trade, takes over as and from June 30th, 1909, the management and working of that portion of the London company's undertaking which is situate within the area of the company. The supply for a period of 18 months to December 31st, 1910, taken and distributed under the agreement, is credited in the year's revenue account, and the cost is included in the item of electricity purchased. The report of the Central Electric Supply Co., Ltd., shows that a dividend of 5 per cent. on the ordinary shares has been declared, in respect of which a sum of £2,500 will, in due course, be payable to the company. The main boiler plant at the Carnaby Street works has been reconstructed with automatic furnaces for the consumption of bituminous coals, and the Mason's Yard works are in process of re-equipment as a transformer substation for high-pressure supply. The depreciation of plant rendered obsolete by these changes amounts up to date to the sum of £10,431. This the directors have provided by taking an amount of £8,500 from the contingency fund, and the balance of £1,931 from the net revenue of the year. They have further carried a sum of £4,000 from the net revenue account to the credit of the contingency fund. The net profits for the year 1910, applicable to dividends on shares, amount to £27,090, plus £2,026 brought forward, less interim dividend paid in August last for half-year ending June 30th, at the rate of 7 per cent. on preference shares, £3,500, 10 per cent. on ordinary shares, £10,000, leaving an amount to be dealt with of £15,616. The directors propose to pay a dividend at the rate of 7 per cent. on the preference shares for the second half-year, requiring £3,500, and a dividend on the ordinary shares for the second half-year of 5s. per share, making, with the interim dividend paid in August last, a total distribution of 10 per cent. for the year, requiring £10,000, leaving £2,116 to be carried forward.

B. of T. units generated and purchased	12,039,123
Quantity utilised—Private supply	9,760,697
Public lighting	139,019
Used on works	300,858
Total	10,200,574
Quantity expended in distribution	1,838,551
Total connections in KW. December 31st, 1910 ..	12,999

The meeting is called for Tuesday, February 14th, at 3 o'clock.

Continental.—FRANCE.—The balance-sheet of La Société Grenobloise de Force et Lumière, of Grenoble, for the last financial year shows a profit of £16,812, as compared with only £3,603 in the preceding 12 months.

GERMANY.—The Gesellschaft der Fabrik Isolierter Drahte zu Elektrischen Zwecken, of Berlin, is declaring a dividend at the rate of 7 per cent. for the last financial year.

Central London Railway Co.

Sir H. Oakley (chairman) presided at the meeting held at the Holborn Restaurant on Thursday last week.

In moving the adoption of the report (see Electrical Review, page 151), the Chairman said the proprietors now numbered 2,743. There was little alteration in the capital account. They had spent £2,300 during the half year on the high level subway to connect the City and South London Railway subway with their own at the Bank. The cost at this subway was to be equally divided between the two companies, and he thought it would be a good thing for both of them. They had commenced the work of the Liverpool Street extension, but to their anxious minds it was going on slowly, which was due to the circumstance that the whole of the station area would be underground. It was bound to be a slow work, but the more they watched the traffic at Liverpool Street the more they were satisfied that there was a great future to be derived from the company's extension there. They were in debt to capital to the extent of £125,000, but not to the outside public, because they were utilising the money they had in hand and in reserve. They had powers to raise £514,000, and this would be required to complete the station and the subway. The revenue was perhaps the most interesting matter before them, because the past year had simply continued the wonderful variation in the description of traffic which it was their good fortune to carry. They had carried 19,995,936 passengers in the half-year on their line of a little over 6½ miles, over which they ran rather more than 400 trains each day each way. Their fees were 1d., 2d. and 3d., and almost any fraction between each of these two sums. During the half-year they had carried 52,495 fewer 3d. passengers than in the corresponding period, out of a total of 2,098,000; they lost 411,000 2d. passengers on a total of 6,333,000; whilst they increased the 1d. passengers by 305,000, making the total at that fare 3,573,000. They also gained 630,000 through passengers, which was a very encouraging feature, although the average receipt per passenger was less than the amount they received in previous years. It meant, however, that the public appreciated and utilised the convenience now offered of being able to book through on to other tube lines. On the whole they thought that the half-year's working of the passenger traffic was satisfactory and encouraging, but they were also bound to recognise that the competition of the road cars and trams and other vehicles had increased materially during the last two years, and they could not avoid anxiety as to the future consequences of this competition. The gross amount they received was £143,433, or £2,824 more than in the corresponding period. There was little to say with regard to the working expenses except that there was a bright spot in connection with rates and taxes. Last year they appealed against the assessments of their property all along the line, and the result had been material reductions. Without pinning himself to figures, he believed that the result would mean in the coming year a saving of £8,000 or £10,000 under that head. They had carried 5¼ passengers for every mile each car ran, and the average receipt per passenger was 1¾d. This was not so good as they hoped when they commenced, but on the other hand, the number of people carried was much greater than they anticipated, and the wonderful expansion of through passengers showed that the public generally were appreciating the convenience of these underground lines. As a result of the half-year's working they proposed to pay 3 per cent. on the undivided ordinary stock, 4 per cent. on the preferred ordinary stock, and 2 per cent. on the deferred ordinary stock, to place £10,000 to reserve, and to carry £33,645 forward. They proposed to add the £10,000 to reserve, having regard to the gradual necessity of providing for the replacement of the road, and of the machinery upon which their traffic depended. He had been asked to tell the meeting the position they occupied with respect to the lighting of the tunnels and the carriages in case of difficulty. In each carriage they had an automatic system, which would light the carriage in case of any failure of the current from Shepherd's Bush, and the tunnel was also separately lighted. There was also a pathway constructed in the tunnel, so that, in case of any accident, the passengers could proceed to a station. Provision was also made for working the lifts in the case of any failure of the electric current. The chairman proceeded to describe the objects of the Bill which the company was promoting for the making of a short line from Wood Lane, to form a connection with the Great Western Co.'s Ealing and Shepherd's Bush Railway. The original intention was to have a subway connection, but as the result of experience, they did not like subways, and preferred a through connection. The Great Western Co. was willing to provide the necessary electrical apparatus along their line to West Ealing, so that the Central London trains could run continuously from end to end, providing a direct route between Ealing and Liverpool Street. The board considered there would be very little risk in regard to this development, for it would only cost them £100,000 or £120,000. The Great Western Co. would bear the cost of the working on their own line, and would, of course, take their proportion of the receipts.

Viscount St. Aldwyn seconded the motion.

Mr. Birt wished to call attention to the reserve fund, although not in any antagonistic spirit to the board. He submitted that by the words the chairman used last year the proprietors were left under the impression that the reserve fund having reached £100,000 was closed. He contended that it was an extraordinary thing that the board should ask them to put £10,000 to reserve again, and he hoped the shareholders would not allow it or the practice would become stereotyped. There was no reason whatever for carrying so large a sum to reserve for every half-year, adequate provision seemed to have been made for repairs and renewals, and only in the past half-year the maintenance of permanent way was at the rate of £500 a mile. The speaker also objected to so large a carry forward, which he said was larger in proportion to the capital than that of any railway company in the kingdom. He submitted that the board had no power to carry forward any sum greater than an amount which was so small as to be indivisible amongst the holders of the junior stocks.

Mr. Fitch drew attention to an analysis of the accounts which had been made in one of the newspapers, of the different tube railways, and he found that their line cost £14,000 a year more than Great Northern and Brompton Railway, although it was three miles shorter.

Mr. J. J. Lewis criticised the cost of management and said an enormous amount of money was spent in the engineering department. They had hardly a man in the department who had not a foreman over him. He thought it was time they had men on the board who knew something of the working of railways.

Mr. C. J. Anderson said he was an old director of one of the first electric railways installed on this side of the Atlantic. At that time they had to face the difficulty of estimating depreciation, but as years went on experience showed that the depreciation required for electrical apparatus was great. With a steam railway the units were small and the engines went into the shops gradually and were scrapped gradually; but in the case of an electric railway with an enormous generating station, there was no disguising the fact that as time went on big sums would be required for the replacement of the large power units; and that, he took it, was the reason for building up the reserve fund. He doubted whether £110,000 was a sufficient reserve fund, in view of the capital invested at Shepherd's Bush, and although as a shareholder he wanted dividends, still he wished to see them honestly earned.

Mr. Barber-Glenn remarked that, although he was not engaged with electric railways, he had a knowledge of other electric undertakings, and seeing they had expended £4,000,000 capital, £110,000 seemed to him quite insufficient as a reserve. Personally, he hoped the directors would continue their policy of building up a reserve.

The Solicitor said he thought there was no question but that it was within the discretion of the board to carry forward what sum they considered right.

The Chairman said the most material point raised was that of working expenses, and he could assure them that that was the subject of constant inquiry and consideration. In comparing these things, they had to consider what had to be done to earn the money, and in their case they had to run continuously from five in the morning till after midnight. They could not do this without a double shift of men, and personally, he did not believe there was a man employed who was not needed. He thought the reserve fund had been sufficiently discussed, and would only add that the recommendation was made after the most careful consideration.

The report was adopted, and subsequently a resolution was passed approving of the company promoting a Bill in Parliament.

Liverpool Overhead Railway Co.

For the half-year ended December 31st, 1910, the directors report that the gross revenue receipts amount to £38,154 and the working expenses to £27,569. The number of passengers carried during the last two years is as follows:—

	Half-year June, 1909.	Half-year Dec., 1909.	Half-year June, 1910.	Half-year Dec., 1910.
First class	548,613	553,409	546,742	567,911
Third class (incldg. tramways ..	2,932,367	3,184,636	3,013,785	3,260,261
Workmen (special return tckts.)	1,419,236	1,477,506	1,529,553	1,563,128
Total	4,900,216	5,215,551	5,090,080	5,391,300

A slight recovery in the trade of the port is reflected in the increase in the traffic and in the revenue. The expenditure shows a further small decrease. The rolling stock and permanent way have been well maintained. The directors find from past experience that certain insurance risks can be reasonably carried by the company, and a sum of £500 has been set aside out of the balance of revenue carried forward to form the nucleus of an insurance fund. The receipts from passenger traffic amount to £36,910, plus miscellaneous receipts and interest £1,244, making £38,154, less working expenses and transfer to renewal fund, £27,569; deduct interest on mortgage debentures and on calls paid in advance, £4,329, and add balance brought forward June 30th, 1910, £5,917, making £12,172; less transferred to insurance fund £500, leaving available for dividend £11,672. Out of this balance the directors recommend the declaration of dividends at the rates of 5 per cent. per annum on the preference shares and 1½ per cent. per annum on the ordinary shares, payable on and after February 17th, leaving a balance of £4,246 to be carried forward.

City of Buenos Ayres Tramways Co. (1904), Ltd.—A final dividend of 1s. 3d. per share is announced for the year ended December, 1910; £3,800 is transferred to general amortisation fund and £65 is carried forward.

Dundee, Broughty Ferry and District Tramways Co., Ltd.—The directors have resolved to pay an interim dividend of 6 per cent. per annum on the preference shares.

Japan.—It is reported from Tokio that the Musashi Electric Railway Co. is about to increase its capital from £350,000 to £700,000, and to commence the construction of a new line between Tokio and Yokohama. According to the scheme, the whole line will be doubled tracked within a period of two years.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
Aberdeen	Feb. 1	2,429	+ 219	35	49,990	+ 1,182	..	..
Ayr	„ 4	354	+ 21	38	11,841	+ 445	8	..
Bath	„ 4	1,253	+ 52	5	3,237	— 69	..	..
Belfast	„ 3	7,990	+ 944	44	181,236	+12,896	37	..
Birkenhead	„ 5	2,029	— 3	44	43,786	+ 941	13·68	..
Birmingham Corp.	Jan. 28	13,791	+ 781	43	298,883	+ 8,374	56·79	..
Blackburn	Feb. 1	1,825	+ 174	44½	47,410	— 976	14·12	..
Blackpool Corp.	„ 2	838	+ 161	..	52,933	+ 705	..	..
Blackpool-Fleetw'd	„ 4	494	+ 127	5	1,205	+ 117	..	..
Bolton	„ 3	4,460	+ 470	15	105,233	+ 2,990	26	..
Bournemouth	„ 1	2,531	— 18	43½	78,344	+ 5,243	21·95	..
Bradford	Jan. 18	9,518	+ 921	43	221,719	+10,535	54·81	..
Brighton	Feb. 5	1,416	+ 18	44½	43,376	..	9·5	..
Bristol	„ 3	10,748	+ 667	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	Jan. 27	416	+ 29	4	845	+ 21	3·65	..
Barnsley	„ 27	331	+ 9	„	611	+ 16	..	..
Barrow	„ 27	438	+ 28	„	816	+ 31	5·37	..
Cavehill	„ 27	112	+ 19	„	217	+ 30	..	..
Devonport	„ 27	835	+ 14	„	1,627	+ 43	8·85	..
Gateshead	„ 27	1,934	+ 168	„	3,745	+ 201	11·25	..
Gravesend	„ 27	339	— 10	„	656	— 16	6·5	..
Greenock	„ 27	1,162	+ 241	„	2,200	+ 426	7·25	..
Hartlepool	„ 27	406	+ 36	„	783	+ 31	6·72	..
Kidderminster	„ 27	156	+ 1	„	308	+ 5	..	..
‡Leamington	„ 27	256	— 21	„	500	— 29	..	..
Merthyr	„ 27	356	+ 2	„	661	— 14	2·9	..
Metropolitan	„ 27	14,721	+2,658	„	28,457	+ 4,535	22	..
Middleton	„ 27	588	+ 76	„	1,054	+ 130	8·5	..
Mid. Joint Com'tee	„ 27	11,186	+ 892	„	21,378	+ 1,182	..	..
Oldham—Ashton	„ 27	1,141	+ 64	„	1,944	+ 116	9·13	..
Peterborough	„ 27	188	+ 6	„	361	+ 13	5·31	..
Potteries	„ 27	3,764	+ 414	„	7,101	+ 741	29	..
Rothesay	„ 27	74	— 4	„	179	+ 1	2·75	..
Southport	„ 27	412	+ 65	„	856	+ 66	8·17	..
S. Metropolitan	„ 27	1,332	+ 42	„	2,595	— 23	..	..
Swansea	„ 27	2,186	+ 133	„	3,994	+ 314	12·5	..
Tynemouth	„ 27	278	+ 46	„	567	+ 30	3·75	..
Weston-s-Mare	„ 27	29	— 16	„	60	— 42	3	..
‡Worcester	„ 27	450	+ 3	„	889	+ 11	5·75	..
Wrexham	„ 27	179	+ 10	„	332	+ 7	..	..
Yorks. Wool. Dist.	„ 27	1,957	+ 232	„	3,794	+ 480	17	..
Miscellaneous	„ 27	371	+ 12	„	715	+ 28	..	..
Burnley	Feb. 4	2,520	+ 352	..	..	..	11·78	1
Burton-on-Trent	„ 5	455	— 32	44	12,104	+ 292	6·72	..
Bury	„ 5	2,130	+ 288	44½	52,104	+ 934	22·5	..
Cardiff	„ 4	4,121	+ 180	45	100,344	+ 1,863	..	..
Carlisle	..	..	..	..	..	..	..	..
Chatham and Dist.	„ 2	1,456	+ 95	5	3,544	— 98	14·98	..
Cork	„ 2	815	+ 29	5	1,961	— 193	9·89	..
†Croydon	Jan. 27	1,465	+ 118	..	72,283	+ 3,375	11·25	..
†Darlington	Feb. 4	191	+ 9	45	9,028	+ 762	..	..
†Darwen	Jan. 27	224	+ 7	43	10,780	+ 35	4·36	..
Dover	Feb. 4	338	+ 30	44	9,758	+ 511	4·75	..
Dublin	„ 3	9,807	+ 441	..	24,341	+ 321	54·25	..
Dundee	„ 1	2,151	+ 84	37⅞	45,014	+ 604	15	..
East Ham	„ 4	1,845	+ 71	44⅞	46,055	+ 2,033	7·87	..
Exeter	„ 3	405	— 29	44	14,095	— 606	5·5	..
Glasgow	„ 4	34,018	+2,393	..	697,297	+38,153	97·75	3·25
Hastings	„ 2	1,339	+ 64	..	..	..	..	..
Huddersfield	..	..	..	..	..	..	..	..
Hull	„ 4	5,459	+ 258	44	122,780	+ 6,819	14·5	..
Ilkeston	„ 2	220	— 10	44	5,643	— 230	..	..
Ipswich	„ 4	633	+ 43	44	18,590	+ 998	10·5	..
Kilmarnock	„ 4	278	+ 24	38	5,812	+ 259	4·25	..
Lancashire United	„ 1	2,367	804	5	5,584	+ 222	39	..
Leeds	„ 4	18,229	+1,233	44	312,374	+11,862	57	..
Leicester	..	..	..	..	..	..	..	..
Leith	„ 4	1,074	+ 61	37⅞	22,825	+ 140	8·72	..
Liverpool	Jan. 25	21,127	+1,067	4	43,409	+ 1,760	116	6·5
‡L.C.C.	„ 25	79,801	+5,018	..	1,796,384	+190,784	132	8
London United	Feb. 4	9,967	+ 229	..	25,766	— 78	..	..
Lowestoft	..	..	..	..	..	..	..	..
†Manchester	„ 4	29,617	+2,618	45	684,423	+22,723	183	..
†Newcastle	„ 4	7,362	+ 440	..	175,892	+ 1,778	14·5	..
Newport	Jan. 28	1,258	+ 69	44	29,577	+ 1,139	14·5	..
Oldham	Feb. 5	3,476	+ 656	45	83,242	+ 2,107	23·5	..
Pontypridd	..	..	..	..	..	..	..	..
Portsmouth	„ 4	3,080	— 15	44	90,304	— 1,407	15·25	..
Preston	„ 1	1,491	+ 122	44	32,200	— 105	..	..
Rotherham	..	..	..	..	..	..	..	..
Salford	„ 6	8,796	+ 619	44½	208,285	+ 5,823	..	..
Sheffield	„ 7	12,038	+1,168	45½	274,609	+17,601	40	..
Southampton	„ 1	1,933	+ 60	44	48,494	+ 1,502	..	..
Southend-on-Sea	„ 1	730	+ 65	44	25,591	+ 2,729	..	..
South Shields	„ 4	1,081	+ 45	44⅞	24,886	+ 19	..	..
Swindon	„ 1	246	— 15	..	6,317	+ 311	..	..
Tyneside	„ 1	7·8	+ 154	5	1,698	+ 88	..	..
Wallasey	„ 21	1,754	+ 161	42⅜	40,775	+ 1,779	..	..
Walthamstow	„ 4	1,135	+ 31	44	31,103	+ 2,087	9	..
West Ham	Jan. 26	4.560	+ 87	43	107,171	+ 5,660	15·25	..
Wolverhampton	Feb. 1	1,702	+ 123	44	41,554	+ 4,416	14·25	..
Cen. London Rly.	„ 4	10,761	— 376	5	27,568	— 241	6·82	..
City & S. Lon. Rly.	„ 5	6,909	+ 186	5	17,785	+ 948	7·26	..
Dublin-Lucan Rly.	„ 3	208	+ 40	5	489	+ 18	7	..
†G.N. and City Rly.	Jan. 28	1,586	+ 42	4	6,898	+ 194	8·5	..
L'pool Overh'd Rly.	Feb. 5	2,708	+ 233	..	6,901	+ 521	6·8	4·3
Llandudno-Col. Bay	„ 3	220	+ 20	9½	1,097	+ 20	..	..
London Elec. Ry. Co.	„ 4	28,000	+1,820	5	71,985	+ 4,160	21·5	..
Mersey Railway	„ 4	3,985	+ 163	5	10,248	+ 285	4·5	..
Metropolitan Rly.	„ 5	33,612	+ 660	..	87,745	+ 2,566	24·5	..
Met. District Rly.	„ 4	28,215	+1,844	5	68,909	+ 4,799	24	..
Anglo-Argentine	„ 4	94,895	+10,909	..	242,860	+30,839	..	..
§Auckland	Jan.	18,059	+2,174	..	109,998	+11,587	23·8	1
Bombay (B.E.T.)	„ 6	5,465	+ 66	..	..	..	..	..
Brisbane	..	..	..	..	..	..	..	..
Brit. Columbia Rly.	..	..	..	..	..	..	..	..
Calcutta	Feb. 4	7,210	+ 312	..	..	..	..	..
Cape Electric T.Ld.	..	..	..	..	..	..	..	..
§Kalgoorlie, W.A.	Dec.	3,792	..	52	43,829	..	20·5	..
§Lisbon	Dec.	1,699	+ 120	..	33,020	+ 1,510	..	..
Madras	Jan. 31	1,502	+ 33	..	3.161	+ 268	..	..
§Montevideo	Jan.	31.945	+2,643	13	82,705	+ 6,410	..	..
†Perth (W.A.)	Feb. 3	3,399	+ 157	..	8,.79	+ 320	29	1

* Compared with the corresponding period of 1910. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

INVESTMENT markets are amongst the steadiest in the Stock Exchange, and the persistant way in which Consols cling to 80 is accepted as a good omen for the best-class securities. Electricity Supply shares show a useful amount of strength. The "revolution" in Mexico has caused a very slight degree of uneasiness amongst the lighting and power market in Latin-Canadians, and prices are no worse.

Home Railway stocks staggered for a day or two beneath the fear of what might happen if the North-Eastern's labour troubles spread southwards, but the rapid settlement of the dispute gave the market fresh confidence, and prices are generally firm. The Brighton Company's meeting produced a statement from the chairman to the effect that the traffic previously lost by tramway competition had been almost completely regained by the electrification of part of the suburban line; City and South London proprietors must have read this statement with mixed feelings. Central London stocks have continued their quiet rise, and the Deferred and Ordinary are the two most favoured. In Metropolitans and Districts there is not much doing for the time being. East Londons, especially the junior Debenture stocks, are better on fresh electrification hopes.

The advance in the dividend on Chelsea Electricity Supply Ordinary shares came as a welcome surprise to the market, and has gone some way in helping the better tone that prevails in that department. With the improvement in values has dawned the discovery usual in cases where people begin to buy—namely, that "there is no stock in the market." In point of fact, however, electric light shareholders, having seen their investments so depressed for years past, are not at all anxious to part with them on the appearance of a little animation, and consequently the demand does find few shares on offer, with dealers more willing to buy than to sell. It seems needless to add that this is a state of affairs to which the market has been for a long time past a stranger.

Brompton Preference are the first in the list to show an advance, but the principal gain is secured by St. James' and Pall Mall Ordinary, with a rise of 15s., after being better still. The company's report is good, though not exciting; allocations are increased, but £8,500 is taken from the contingency fund to reconstruct the main boiler plant. Westminsters rose 5s., and are now 8¼. It would be interesting to know whether the company has yet disposed of the block of Preference shares which was understood to have been left over from the last issue. Improvements are noticeable in Charing Cross, City, County, Metropolitan and Chelsea Ordinary shares. The decision of the Holborn Borough Council to recommend gas lighting of the street for the ensuing decade is indeed surprising, in view of the better and cheaper results obtainable from electricity, as demonstrated in the recent tests of both. Edmundson's 4½ per cent. Debenture spurted 3 points on a small inquiry for the stock. Brush First Debenture rose 3 and the Seconds 2, on the strength of the market generally. Edison's are up to 2s. 6d., and may go better; the company is doing well with its metal-filament lamps.

Mexico has been "enjoying" one of those mild revolutionary outbreaks to which the countries of that part of the work seem to take as naturally as children to chocolate, and this has placed a mild check upon activity in the lighting and power issues of the peninsula. The market had been strong, but turned backwards as the cables came in about the fighting on the frontier. Small rises remain in Mexican Light and Power, Mexico Trams and Pachuca Fives. Rio Trams touched 112 before reacting to 111¼, the company's bonds remaining firm. Canadian General Common and Preferred keep about 109 and 120½ respectively. Shawinigan Water lost a little of its last week's big rise, the price easing off to 115½, while the 5 per cent. first mortgage bonds are steady at 10s.

British Electric Traction Ordinary and Preference have strengthened, and the London United Tramways issues show decided strength. The Debenture stock has risen 4 points. Cape Electric Trams rose to 15s., reacting to 12s. La Plata Trams hardened to 14s., and Anglo-Argentine Tramways second Preference continued to improve. Metropolitan Tramways Ordinary advanced to 20s. There is a very clever clique of speculators taking in hand one low-priced industrial—with merits—after another, and hoisting the price to a level at which they can get out with a good profit.

The meeting of the Anglo-American Telegraph Company led to a fall in the prices of the stocks, the chairman saying that the Western Union arrangement had some legal difficulties to surmount before it could become operative. Telegraph issues, as a whole, are very quiet. West India and Panama reacted smartly on profit-taking by the speculating clique already mentioned. Marconis are better and National Telephone Preferences have again appreciated.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1907.	1908.	1909.	1910.	Closing Quotations Jan. 31st.	Closing Quotations Feb. 7th.	Business done week ended Feb. 7th, 1911. Highest	Lowest.	Rise + or Fall —	Present Yield per cent.
		*										£ s. d.
300,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	5⅜ — 6⅛	5⅜ — 6⅛	5⅜	..	..	Nil.
$263,244,000	Do. 5 % Deb. Red. Iss. at 98 % script all paid	Stock	5 %	5 %	5 %	5 %	96 — 98	96 — 98	96¼	96½	..	5 2 0
$255,196,000	American Telephone & Telegraph, Cap Stock ..	$100	8 %	8 %	8 %	..	147 —149	149 —151	151½	149⅝	+2	5 6 0
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	94 — 96	93 — 95	..	..	—1	4 4 3
545,920	Anglo-American Telegraph	Stock	3½%	£3 4s.	3⅝%	3⅝%	70⅛ — 72½	69⅛ — 71½	70⅛	70	—1	5 4 11
3,227,040	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	114 —115	112⅝ —113⅝	114⅝	112½	—1½	5 5 6
3,227,040	Do. do. do. Deferred	Stock	1 %	8/-	25/-	30/-	28½ — 28⅝	27⅝ — 28⅛	28⅛	27⅝	— ⅛	5 7 0
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	6 15/16 — 7⅛	6 15/16 — 7 1/16	7⅛	7 1/16	..	5 11 4
2,462,309	Commercial Cable, Stlng. 500 year 4% Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	86 — 88	86 — 88	86⅝	86	..	4 10 11
16,000	Cuba Telegraph	10	6 %	6 %	6 %	..	9 — 9½	9 — 9½	9⅛	..	..	6 3 1
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	..	17 — 18	17 — 18	..	..	..	5 11 1
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	3⅜ — 4	3⅜ — 4	..	..	..	5 0 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10%	8⅛ — 8⅜	8⅛ — 8⅜	..	..	..	5 14 3
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	99½ —101½	99½ —101½	..	..	..	4 8 8
60,710	Direct United States Cable	20	4½%	4½%	4 %	5 %	15⅜ — 16	15⅜ — 16	15 15/16	15⅝	..	4 17 10
32,500	Direct W. India Cable, 4½% Reg. Deb., 1 to 1,300, R.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	135 —138	135 —138	137	135	..	5 1 5
2,000,000	Do. 8% Pref. Stock	100	8½%	8½%	8½%	8½%	84 — 86	84 — 86	85	84	..	4 1 5
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	100⅛ —102⅛	100⅛ —102⅛	102	..	..	3 18 1
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12 15/16 — 13⅛	13 — 13⅛	13⅛	13	+ ⅛	5 3 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 8
200,000	East. & S. Afric. Tel., 4 % Mt. Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
181,127	Globe Telegraph and Trust	10	5⅞%	5⅞%	5⅞%	..	10⅜ — 10⅝	10⅜ — 10⅝	10⅝	10 7/16	..	5 9 5
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	13⅜ — 13⅝	13⅜ — 13⅝	13⅝	13 15/16	+ ⅛	4 8 1
150,000	Great Northern Telegraph, of Copenhagen..	10	20 %	18 %	18 %	..	32 — 33	32 — 33	..	..	..	5 9 1
17,000	Indo-European Telegraph	25	18 %	13 %	13 %	..	55 — 57	55 — 57	..	..	..	5 14 0
$41,380,400	Mackay Companies Common	$100	4 %	4 %	4½%	5 %	94 — 97	94 — 97	..	..	..	4 7 8
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	77 — 79	77 — 79	..	..	..	5 1 3
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	2 — 2 1/16	1 15/16 — 2 1/16	17/9	16/6	+ 1/16	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	..	1 — 1	1 — 1	..	..	..	6 0 0
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	29/32 — 30/32	29/32 — 30/32	..	..	..	5 11 1
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106⅞ —107⅛	106⅞ —107⅛	107⅛	106⅞	..	5 11 4
3,725,000	Do. do. Def. Stock	100	6 %	6 %	6 %	6 %	134 —136	134 —136	135½	134½	..	4 8 3
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10 — 10⅜	10 — 10⅜	10⅜	..	..	5 11 8
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10 — 10⅜	10⅛ — 11	11	..	+ ⅛	5 9 1
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 15/32 — 5 17/32	5⅝ — 6	5 21/32	5 13/16	+ 3/32	4 3 4
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	..	..	..	3 10 0
1,983,593	Do. do. 4 % Deb. Stock Red... ..	100	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..	4 0 0
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid..	1	8 %	8 %	8 %	..	1 3/32 — 1⅛	1 3/32 — 1 5/32	..	..	+ 1/32	4 10 2
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..	..	4 7 3
195,955	Do. do. do. 4 % Red. Deb. Stock..	100	4 %	4 %	4 %	4 %	87 — 89	87 — 89	..	..	..	4 9 11
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	97⅜ — 99⅜	97⅜ — 99⅜	..	..	..	4 0 5
11,899	Reuter's	8	5 %	5 %	5 %	..	7⅞ — 8	7⅞ — 8	..	..	..	5 0 0
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	96½ — 98½	96⅝ — 98½	..	..	..	4 11 5
9,992	Submarine Cables Trust..	Cert.	6 %	6 %	6 %	..	132 —135	133 —136	..	..	+ 1	4 8 3
150,000	United River Plate Telephone	5	8 %	8 %	8 %	..	7⅛ — 7⅜	7⅛ — 7⅜	7 7/16	7⅜	..	5 6 8
40,000	Do. 5% Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	5 5/16	..	..	4 6 11
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	..	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	4 3 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97½ — 99½	97½ — 99½	..	..	..	4 0 5
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	..	13⅜ — 14	13⅝ — 14⅜	13 13/16	13½	+ ⅛	4 19 1
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	99½ —101½	99½ —101½	..	..	..	3 18 10
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	2 5/8 — 2 11/16	2 5/8 — 2⅝	51/10½	45/-	+ 3/16	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10 — 10½	10 — 10½	10½	10⅛	..	5 14 3
4,669	Do. do. 6 % Cum. 2nd Pref.	10	£2 6	15 %	14½%	..	8⅝ — 9¼	8⅝ — 9¼	..	..	..	6 9 9
80,000	Do. do. 5 % Debs., Nos. 1 to 800 ..	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5% Cum. 1st Pref. 1 to 640,000	5	..	..	5 %	..	4 13/16 — 5 1/16	4 13/16 — 5 1/16	100/-	98/11½	..	4 19 3
500,000	Do. 5 % 2nd Pref., 800,000 to 1,300,000	5	..	..	5 %	..	4⅝ — 4⅝	4 7/16 — 4 11/16	92/6	..	+ 1/16	5 8 1
4,465,674	Do. 4 % Deb. Stock	Stock	..	4 %	4 %	4 %	91½ — 93	91½ — 93	99⅜	92	..	4 6 0
329,002	Auckland E. Trams, 5 % 1st Mort Deb. Stock ..	100	5 %	5 %	5 %	5 %	101½—103½	101½—103½	..	..	..	4 16 7
880,000	Babcock & Wilcox, 1 to 880,000	1	20 %	20 %	24 %	..	5⅜ — 5⅝	5⅜ — 5⅝	5 7/16	5 1/16	..	4 2 1
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	..	1⅜ — 1½	1⅜ — 1½	..	..	..	4 0 0
600,000	British Columbia E. Rail Def. Ord. Stock	100	8 %	8 %	8 %	..	145 —148	145 —148	146⅜	146½	..	4 10 11
600,000	Do. Pref. Ord. Stock	100	5 %	6 %	6 %	..	126 —130	126 —130	..	..	..	4 8 6
600,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	..	110 —113	110 —113	111½	..	..	4 9 3
280,800	Do. 4½ % 1st Mort. Deb., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —104	102½—104½	..	..	+ ½	4 6 2
210,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
133,801	British Electric Traction	10	Nil	Nil	Nil	..	1⅜ — 1⅝	1 7/16 — 1 11/16	30/-	27/6	+ 1/16	Nil
161,487	Do. do. 6 % Cum. Pref.	10	3 %	1⅜%	Nil	..	3⅜ — 4⅛	3⅝ — 4⅜	82/6	76/3	+ ⅛	Nil
1,473,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	91 — 95	91 — 96	99⅛	99½	+ ½	5 4 2
528,936	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	73 — 78	73 — 78	..	..	..	5 15 5
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	..	6⅞ — 7⅛	7 — 7⅛	7⅛	7⅛	+ ⅛	6 13 4
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	5⅝ — 6⅛	5⅝ — 6⅛	6 1/16	..	..	4 16 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
201,579	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
500,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 75,000	5	Nil	Nil	Nil	..	⅛ — ¼	⅛ — ¼	..	..	..	Nil
1,941,853	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	56 — 59	54 — 57	55	..	— 2	7 0 4
50,000	‡Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	..	9/16 — 11/16	9/16 — 11/16	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,888	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	..	0 — ⅛	0 — ⅛	..	..	..	Nil
199,885	Do. do. Non-cum. 7 % Pref... ..	2	Nil	Nil	Nil	..	0 — ⅛	0 — ⅛	..	..	..	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	37 — 42	40 — 45	..	..	+3	10 0 0
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	21 — 25	23 — 28	..	..	+2½	16 1 6
187,610	Calcutta Trams, 1 to 187,610	5	6 %	4½%	4½%	..	5 — 5⅛	5 — 5⅛	5 1/16	..	..	4 1 10
47,295	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	5	5 %	5 %	5 %	..	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..	5 0
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	98⅜	..	..	4 10
35,000	Callender's Cable Construction shares	5	15 %	15 %	10 %	..	9⅛ — 9⅜	9⅛ — 9⅜	9⅜	9 1/16	..	5 0
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	4⅜ — 5	4⅜ — 5	97/6	..	..	4 18
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
491,223	Cape E. Trams., 1 to 491,223	1	Nil	Nil	Nil	..	⅞ — 1	⅞ — 1	14/6	12/9	+ ⅛	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	12 %	12½%	17½%	..	3⅝ — 3¾	3 5/16 — 3 7/16	65/6	63/-	+ 1/16	5 6 1
205,369	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4 %	4½%	4½%	103 —106 xd	103 —106	105	103½	..	4 4 11
1,864,720	Central London Railway, Ord. Stock	Stock	3 %	3½%	3 %	3 %	65 — 67	66 — 68	67⅛	66⅜	+1	4 8 3
672,640	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	86½	..	..	4 12 0
672,640	Do. do. Def. do.	Stock	2 %	2½%	2 %	2 %	47 — 49	48 — 50	49	..	+1	4 0 0
1,480,000	City and South London Railway	Stock	2½%	1½%	1½%	1½%	27⅛ — 28⅛	27⅛ — 28⅛	28⅜	28	..	3 10 2
85,000	Crompton & Co., Nos. 1 to 85,000	5	5 %	Nil	Nil	..	⅛ — ¼	⅛ — ¼	..	..	..	Nil
100,000	Do. 5 % 1st Mort. Reg. Debs., 900 of £100, and 901 11,000 of £50 Red	..	5 %	5 %	5 %	5 %	70 — 80	70 — 80	..	..	..	6 0 5

* Unless otherwise stated, all shares are fully paid. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Jan. 31st.	Closing Quotations Feb. 7th.	Business done week ended Feb. 7th, 1911.		Rise + or Fall —	Present Yield per cent.
		*	1907.	1908.	1909.	1910.			Highest	Lowest		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	6 %	5 %	..	87/- — 91/-	87/- — 91/-	..	..	..	5 2 7
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	7/8 — 1 1/16	1 — 1 1/8	..	..	+ 1/16	5 6 8
265,430	Do. do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	97 —100	97 —100	..	..	..	4 10 0
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12½ — 13½	12½ — 13½	..	..	..	4 8 11
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	2½ %	Nil	Nil	..	3/16 — 5/16	3/16 — 5/16	..	..	+ 1/16	Nil
17,139	Do. "A" shares, 01—017,139	5	2½ %	Nil	Nil	..	1 — 1½	1 — 1½	..	..	..	Nil
807,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	61 — 66	61 — 66	..	..	..	6 1 3
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	77 — 80	77 — 80	..	..	..	6 5 0
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	..	11/16 — 7/8	3/4 — 1	20/6	17/6	+ 1/16	Nil
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	7 %	7 %	7 %	..	1 13/16 — 2 1/16	1 13/16 — 2 1/16	..	..	+ 1/8	6 10 3
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	8 — 8½	8 — 8½	..	..	..	5 17 8
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	80 — 84	80 — 84	..	..	..	4 15 3
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	1/16 %	Nil	Nil	..	3/4 — 1	3/4 — 1	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10½ — 10¾	10½ — 10¾	..	..	..	6 10 3
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103 1/8	102 —103 1/8	..	..	..	4 16 10
40,000	Henley's (W.T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	..	12½ — 13	12½ — 13	12 9/16	..	..	5 15 5
40,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	..	5 — 5¼	5 — 5¼	..	..	..	5 4 8
150,000	Do. do. 4½ % Mort. Deb Stock	Stock	4½ %	4½ %	4½ %	4½ %	107 —109	107 —109	108½	..	..	4 5 9
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10 %	10 %	10 %	..	15⅝ — 16⅛	15⅝ — 16⅛	..	..	..	6 4 0
37,500	†Liverpool Overhead Railway, Ord.	10	1/16 %	Nil	Nil	1½ %	1⅝ — 1⅞	1⅝ — 1⅞	..	..	..	9 4 7
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	6⅝ — 7⅛	6⅝ — 7⅛	..	..	..	6 15 7
600,070	London United Trams. (1901) 1 to 50,077	10	3 %	Nil	Nil	..	1⅛ — 2⅛	1⅛ — 2⅛	..	..	..	Nil
399,930	Do. do. 60,008 to 100,000	10	3 %	Nil	Nil	..	1⅛ — 2⅛	1⅛ — 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	3⅓ %	Nil	..	1⅝ — 2⅛	1⅝ — 2⅛	42/6	40/-	+ 1/8	..
1,649,930	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	65 — 69	69 — 73	..	..	+ 1/4	5 9 7
5,732,062	Metropolitan Consolidated	100	1/16 %	1/16 %	1 %	1½ %	40⅜ — 41½ xd	39½ — 40	40⅝	39⅝	—1½	2 16 8
2,640,914	Do. Surplus Lands	100	2½ %	2½ %	2⅝ %	2½ %	63 — 65 xd	63 — 65	64⅛	63½	..	4 3 4
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	26½ — 27½	26½ — 27	27⅛	26⅞	— ⅛	Nil
391,337	Metropolitan Electric Trams., Ord.	1	..	4½ %	5⅝ %	..	2⅜ — 1 3/32	1⅛ — 1 1/16	20/-	19/6	+ 3/32	4 14 1
314,016	Do. do. Defd.	1	Nil	Nil	Nil	..	3/32 — 3/32	3/32 — 3/32	4/3	3/9	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	1 — 1	1 — 1	18/9	..	..	5 0 0
589,183	Do. do. 4½ % Deb. Stock Red.	100	4½ %	4½ %	4½ %	..	99½ —101½	99½ —101½	100⅝	100	..	4 8 8
$10,823,200	Mexico Trams Co., Common Stock	..	..	..	6 %	..	125 —127	126½ —127½	128⅜	126⅜	+1½	4 14 1
$9,000,000	Do. 1st Mort. 50-year 5 % Gld. Bds.	..	..	5 %	5 %	..	99½ —100½	99½ —100½	100⅛	99⅛	+ ⅛	4 19 6
245,000	Potteries Electric Traction	1	4 %	Nil	2 %	..	1/16 — 1/8	1/16 — 1/16	4/-	..	..	6 8 0
245,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	3/8 — 1/2	3/8 — 1/2	11/-	..	..	7 5 5
245,000	Do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	80 — 83	80 — 83	..	..	..	5 8 5
37,350	Telegraph Construction and Maintenance	12	17½ %	15 %	17½ %	20 %	39 — 41	39 — 41	39	38½	..	5 17 8
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
1,000,000	Underground Electric Railway, 5 % Prior Lien	..	..	5 %	5 %	..	102½ —103½	102½ —103½	103⅛	103⅛	..	4 16 7
2,818,700	Do. do. 4½ % Bonds	..	..	4½ %	4½ %	..	96 — 98	95 — 97	96½	95⅝	—1	4 12 9
4,928,050	Do. do. 6 % Income Bonds	..	..	..	..	1 %	44 — 46	43 — 45	46½	44	—1	2 4 5
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	10 %	5 %	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	6 %	3 %	..	1 — 1½	1 — 1½	..	..	..	10 0 0
215,769	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	55 — 65	55 — 65	..	..	..	6 3 1

ELECTRICITY SUPPLY COMPANIES.

80,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	..	7 — 7⅛	7¼ — 7⅜	7⅜	7 5/16	+ 1/16	6 9 0
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	6 15/16 — 7⅛	7 — 7⅛	7⅛	..	+ 1/8	4 13 4
402,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —103	99 —103	100	..	..	3 17 8
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	..	3⅞ — 4¼	3⅞ — 4⅜	90/7½	..	+ 1/8	5 14 3
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½ %	4½ %	4½ %	..	4⅛ — 4⅜	4⅛ — 4⅜	86/8	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½ %	4½ %	4½ %	..	3⅞ — 4¼	3⅞ — 4¼	..	..	..	5 7 6
445,786	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	97	..	..	4 2 6
49,486	Chelsea Electricity Supply, Ord.	5	4½ %	4½ %	4½ %	5 %	3¾ — 4⅛	4 — 4⅛	..	..	+ 1/16	5 11 1
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½ %	4½ %	4½ %	4½ %	98 —100	98 —100	..	..	..	4 10 0
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	7 %	..	11⅜ — 12½	11⅞ — 12⅜	12 3/16	13	+ 1/8	5 13 2
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	..	12 — 13	12 — 13	12⅜	12½	..	4 12 4
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	118 —122	118 —122	..	..	..	4 2 0
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½ %	4½ %	4½ %	4½ %	99 —102	99 —102	..	..	..	4 8 8
50,000	County of Durham Electrical Power, Ord.	5	2 %	Nil	Nil	..	1⅝ — 2	1⅝ — 2	..	..	..	Nil
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	..	2⅝ — 3⅛	2⅝ — 3⅛	..	..	..	7 16 10
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	5 %	5 %	5 %	92 — 94	92 — 94	..	..	..	5 6 5
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	..	7⅜ — 7⅞	7⅝ — 8⅛	7⅞	7⅞	+ 1/8	6 3 1
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	..	10½ — 11	10½ — 11	10⅛	..	..	5 9 1
450,000	Do. do. 4½ % Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	104 —107	104 —107	106	..	..	4 4 1
450,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	98 —101	98 —101	100⅛	99¾	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	Nil	Nil	Nil	..	1⅛ — 2	1⅛ — 2	..	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½ %	4½ %	4½ %	4½ %	73 — 76	74 — 79	..	..	+3	5 13 11
$8,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	5 %	5 %	..	82 — 84	82 — 84	84	..	..	5 19 1
10,000	Folkestone, 1 to 10,000	5	5½ %	5½ %	5½ %	..	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	5 12 10
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	..	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..	4 11 11
94,350	Do. 4½ % 1st Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	97 —100 xd	97 —100	..	..	..	4 10 0
15,000	Hove, 1 to 15,000	5	8½ %	8½ %	8½ %	..	6⅝ — 7⅛	6⅝ — 7⅛	..	..	..	5 19 4
$1,526,500	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	5 %	5 %	..	101 —103	101 —103	102	..	..	4 17 1
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	8 %	8 %	..	6¼ — 6⅜	6¼ — 6⅜	6 7/16	..	..	5 18 6
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	93 — 95 xd	93 — 95	..	..	..	4 4 3
111,000	London Electric Supply Corporation, Limited, Ord.	3	2½ %	3 %	2 %	..	1⅝ — 2	1⅝ — 2	..	..	..	3 0 4
90,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	..	4⅛ — 5¼	4⅛ — 5¼	5 1/16	..	..	5 14 3
867,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	90 — 93	90 — 93	..	..	..	4 6 0
200,000	Metropolitan Electric Supply, 1 to 100,000	5	6¼ %	5 %	5 %	..	4¼ — 4⅜	4⅜ — 4⅝	91/3	90/-	+ 1/8	5 2 7
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½ %	4½ %	4½ %	..	4 15/16 — 4 1/16	4⅜ — 4½	90/-	..	+ 1/16	5 0 0
250,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½ %	4½ %	4½ %	4½ %	100 —103	100 —103	..	..	..	4 7 5
248,000	Do. 3½ % Mort. Deben. Stock Redeem.	Stock	3½ %	3½ %	3½ %	3½ %	82 — 85	83 — 86	..	..	+1	4 1 5
$5,929,600	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	5 %	88¾ — 89¾	89 — 90	89¾	89¼	+ ¼	5 11 1
$13,585,000	Do. Light and Power Co., Ord., Common	$100	4 %	3½ %	4 %	..	92 — 94	93½ — 94½	95	93½	+1	4 4 8
$5,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	7 %	7 %	..	109 —111	110½ —111½	111	110	+ ½	6 5 10
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	5 %	5 %	5 %	96½ — 97½	94 — 95 xd	95⅞	94½	..	5 5 3
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½ %	4½ %	4½ %	4½ %	96 — 98	96 — 98	..	..	..	4 11 10
180,491	Newcastle-on-Tyne, 1 to 137,500	5	8 %	2½ %	4 %	..	3⅜ — 4¼	3⅜ — 4¼	..	..	..	2 12 9
137,500	Do. 5 % Pref., 1 to 137,500	5	5 %	5 %	5 %	..	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	5 2 7
150,000	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,500	100	..	..	5 %	..	97½ — 99½	97½ — 99½	..	..	..	5 0 6
10,852	Notting Hill Electric Lighting	10	7½%	7 %	7½%	..	11⅛ — 12⅛	11⅛ — 12⅛	..	..	..	5 12 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 ..	7 %	..	6½ — 6⅞	6½ — 6⅞	..	..	..	5 3 8
120,000	River Plate Elcty. Co. Ord.	Stock	6 %	8 %	9 %	..	228 —238	228 —238	..	..	..	3 15 8
100,000	Do. do. 6% Non Cum. Pref.	Stock	6 %	6 %	6 %	..	103 —113	103 —113	..	..	..	5 6 2
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	101⅛ —103⅛	102 —104	103⅛	..	+ ⅛	4 16 3
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	10%	7⅞ — 8⅛	8⅛ — 9	8⅜	..	+ ⅛	5 11 1
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6⅞ — 7⅜	6⅞ — 7⅜	7	..	..	4 0 6
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	85 — 87	86 — 88	..	..	+1	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	Nil	1⅜ — 2½	1⅜ — 2	..	..	— ½	Nil
65,000	South London Electric Supply, Ord.	4	4 %	5 %	5 %	5 %	3 — 3⅜	3 — 3⅜	..	..	..	5 19 5
100,000	Do. do. 5 % 1st Mort. Deb.	100	..	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 3
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½ %	2½ %	Nil	..	3/16 — 3/8	3/16 — 3/8	..	..	..	Nil
142,988	Do. do. 7 % Pref.	1	7 %	7 %	7 %	..	1 3/16 — 1 5/16	1 3/16 — 1 5/16	20/6	..	..	6 16 7
240,000	Do. do. 4½ % 1st Deb. Stk.	100	4½ %	4½ %	4½ %	4½ %	96 — 99	97 — 99	..	..	+ ½	4 10 11
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	3/16 — 1/4	3/16 — 1/4	..	..	— 1/16	20 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	1½ — 2½	1½ — 2½	40/-	..	..	11 2 0
271,700	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½ %	4½ %	4½ %	4½ %	79 — 83	79 — 83	81½	80½	..	5 7 2
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	5 %	..	..	25/32 — 27/32	13/16 — 7/8	..	..	+ 1/32	5 14 3
110,000	Westminster Electric Supply, Ord.	5	10 %	10 %	10 %	10%	7½ — 8½	8 — 8¼	..	..	+ ¼	5 17 8
81,270	Do. do. 4½ % Cum. Pref. (Reduced from 5% since 31st Dec., 1905)	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	5	..	..	4 3 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4 per cent. January 26th. 1911.

FUEL SUPPLY CONTRACTS ON A HEAT-UNIT BASIS.

II.—Germany and Switzerland.

By JOHN B. C. KERSHAW.

The writer contributed to the issue of the Electrical Review for January 7th, 1910, an article describing the difficulties that had been met with in applying the heat-unit principle of purchase to fuel contracts in this country, and giving details of the experience of two Lancashire firms who had tried the new system with beneficial results.

In the present article it is the purpose of the writer to give information regarding the progress of the movement for instituting more scientific control of fuel supply in Germany and Switzerland.

In the former country considerable progress has been made during the last two years; and in their report for the year 1909, the Committee of the Hamburg Smoke Abatement Society state that an increasing proportion of the members of the Society are taking samples and having tests made of their fuel deliveries. Over 1,000 fuel tests were made at the official testing laboratory of the Society in Hamburg in 1909, and it is expected this total will be largely exceeded by the figures for the current year. The chief engineer of the Smoke Abatement Society—Herr Nies—is himself firmly convinced of the value of chemical and calorific tests for checking the quality of the deliveries of fuel. The Hamburg Society which at the end of 1909 had 365 members and over 1,300 boiler and other furnaces under their control, have arranged to undertake the regular sampling of their fuel supplies for those members who desire to be relieved of this work.

This is a great step in advance, for, as pointed out in the first article, to obtain a really fair average sample of coal or slack demands more skill and knowledge of sampling than is generally found in those who are charged with this work, and the slow progress of the movement in this country is partly due to this difficulty.

The actual testing of the fuel samples in Hamburg is undertaken by an independent fuel expert, Dr. Aufhäuser, who is head of the Thermo-chemische Prufungs und Versuchs Anstalt, or, in plain English, of the Thermo-chemical Testing and Research Laboratory in Hamburg. The following are the details of the basis upon which fuel is valued:—

An average sample of the fuel is taken from the first or trial delivery after discharge at the consumers' works, and this is carefully tested at the official testing laboratory for moisture, ash and calorific value. The latter value is calculated on the assumption that the products of combustion of the fuel pass away in the state of vapour at 212° F., and with the aid of this result the calorific value of the *combustible portion* of the fuel is also calculated.

The regular samples of fuel taken to check the quality of the further deliveries are only tested for the percentage of water and ash; and from the results of these tests the calorific value is *calculated* by aid of the figure obtained from the first or guarantee test. Should this calculated value deviate in either direction from the guaranteed value, by more than the difference allowed by the terms of the contract, an addition to, or deduction from, the price follows.

In those cases where doubt exists as to the correctness of the results, which in some cases may vary on account of a change in the calorific value of the combustible matter of the coal, the sample is submitted to all three tests, and if a different calorific value is found by the direct test, a correction is made accordingly.

It will be seen that this method of checking the fuel deliveries, differs in two respects from that practised in this country. In the first place, the guaranteed calorific value of the fuel is based upon the *combustible* matter in the same, and is calculated for gases escaping at 212° F.; and in the second place, the regular samples of the fuel are only tested for moisture and ash, and the calorimeter tests are only repeated, in cases of dispute.

As regards these modifications, there is no doubt much to be said for the change. A fuel consists, from the practical man's point of view, of combustible and incombustible matter, the latter being made up of water and ash. If the fuel comes always from the same seam in the same pit, the calorific value of the combustible portion of the coal ought to be a constant, and not a variable value. The variables are the moisture and ash, and by estimating the percentage of these in each sample, and by calculating the value of the remaining combustible with the aid of the value obtained in the first test, one can obtain the calorific value of the fuel actually delivered, with a minimum of time and expense.

But this system of valuation ought to be checked, say, monthly or quarterly, by repeat tests with the calorimeter of the actual heat value of the fuel, and the latter figure should be used until another determination is made. This will guard against error due to the slow changes in character and quality which undoubtedly occur in the working of some seams of coal, especially when the thickness is diminishing.

As regards the assumption that the exit gases from the combustion of the fuel are always cooled to 212° F., and the correction of the calorific value accordingly, this method of expressing the value is supposed to have the advantage, that it renders the calculations of the boiler efficiencies more simple, and that one can more easily judge from the calorimeter the test result, the actual steam raising capacity of the fuel. As a rule, English calorific test results are based upon the exit gases at 15° C., and the values obtained in English and German calorific tests of fuel are, therefore, not comparable until allowance has been made for this difference in the method of calculation. But no boiler is so efficient as a heat abstractor, that the exit gases escape at a temperature of 212° F. The German test results still require correcting, therefore, for the difference between 212° F. and 560° F., or 600° F., which is generally the temperature of the escaping gases, and the simplifying of the calculations required when estimating boiler efficiencies, is thus more apparent than real.

Below are a group of test results obtained by this method at the official fuel-testing laboratory of the Hamburg Smoke Abatement Society, and taken from the last annual report of the Society:—

—	Percentage of—			Calorific values in Centigrade units.	
	Moisture.	Ash.	Combustible.	Raw coal.	Combustible.
Durham coal ...	1·6	2·2	96·2	7,951	8,273
	4·6	15·8	79·6	6,339	7,999
	2·6	6·9	90·5	7,350	8,139
Northumberland coal	1·4	13·4	85·2	6,907	8,115
	5·4	8·7	85·9	6,840	8,001
	12·1	5·5	82·4	6,413	7,871
Yorkshire coal...	3·5	7·3	89·2	7,145	8,034
	6·4	4·8	88·8	6,987	7,912
	3·7	3·3	93·0	7,526	8,116

The above calorific tests require multiplying by the factor 1·8 to obtain the corresponding values in British thermal units, and it will be seen that there is a margin of 402 Centigrade units (723 B.TH.U.), between the highest and lowest results, when based on pure coal or combustible. This difference proves that, even after the two variables moisture and ash have been eliminated from the coal, considerable variation exists in the calorific value of the coal mined in different collieries and seams in the North of England, and that the Hamburg system of valuation, if adopted, must be used with discretion and commonsense.

Switzerland.

As regards the progress of scientific methods of controlling fuel supplies in Switzerland, the State authorities in that country established in 1907 at a cost of £2,000, a well-equipped fuel testing laboratory at Zurich, and have since 1908 based all contracts for the supply of fuel to the State Railways, upon calorific tests. The principle employed here, is to fix an average heat value for the fuel being delivered (in this case German and French briquetted fuel), and to deduct from or add to the price, a proportionate sum, for every 50 heat units (90 B.TH.U.), by which the calorific value as delivered, differs from this standard. An illustrated description of this State fuel-testing laboratory at Zurich, appeared in the issue of the *Engineer* for June 12th, 1908,

and it was then stated that over 3,000 samples of fuel had been tested in the first year of its existence.

Most of these represented German fuels, for Switzerland has to import all her coal, at an annual cost of £3,000,000. The remaining samples were of Belgian, French and English fuels. The director of this laboratory (Prof. Constam) states that this extensive examination of imported fuels in Switzerland, both for the State and private consumers, has tended to enlighten the buyers as to the qualities and economic value of the fuels from the various countries and collieries, and has also contributed towards the classification of fuels according to their heating power or value.

The Professor closes his account of the Zurich fuel-testing laboratory by expressing the hope that before long the calorific power or heating value will be adopted universally as the basis for coal contracts in place of the vague term "evaporative power," or the percentage of combustible matter.

REVIEWS.

The Life of William Thomson, Baron Kelvin of Largs. By Silvanus P. Thompson. With Bibliography, List of Patents, &c. In 2 vols. London: Macmillan & Co. Price 30s. net.

The career of a man could scarcely fail to be fascinating—aye, entrancing—about whom it was once said by a Cambridge Senate House Examiner: "You and I are just about fit to mend his pens."

Apart from his considerable academic experience, Prof. Silvanus Thompson was in a peculiarly good position to act as Lord Kelvin's biographer, for whilst not open to the objection of being a member of the family, he is at the same time thoroughly versed in the great man's work—in addition to possessing very considerable powers of investigation and research.

The biography is so perfect a production that we are unwilling to indulge in any carping criticism, and we consider the best plan is to give an indication of the contents of the volumes by a *résumé* of Kelvin's career, with brief references to his characteristics, tastes and mode of life.

An idea of Lord Kelvin's achievements may perhaps be best gathered from the fact that the distinctions he received occupy no fewer than seven pages in the biography, whilst a bibliography of his printed books, scientific papers, lectures and addresses, fills as many as 50 pages, a list of his patents occupying three.

As Prof. (later Sir William) Thomson, Lord Kelvin attained the blue ribbon of the scientific world by becoming President of the Royal Society in 1890, remaining so for the usual five years. (He had been a Fellow since 1851, having een elected when only 27 years old; he had received a Royal Medal in 1856, and the Copley Medal in 1883.) To take but one other example of the leading positions occupied by him for several years, it may be noted that Lord Kelvin became President of the Society of Telegraph Engineers in 1884, again when it had become the Institution of Electrical Engineers in 1889, and yet for the third time in the year of his death.

Lord Kelvin combined theory with practical research, engineering and commercial application to an altogether remarkable degree; and it was this application of theory to practice by a single mind which constituted the difference between Lord Kelvin, on the one hand, and Huxley, Tyndall, or Faraday on the other, whilst also rendering possible those great inventions which have been and still are of such inestimable value to the whole world. His navigational devices alone have saved thousands of lives and millions' worth of property, whilst his electric telegraphic instruments were the means of putting ocean telegraphy on a permanent commercial footing.

His industry never seemed to weary, and he appeared to take rest by returning from one difficulty to another—difficulties that would appal most men, and be faced with enjoyment by no one else. Lord Kelvin's extreme simplicity and modesty—together with his real goodness and religious life—were perhaps the greatest charms in the character of so great a man of science, and one who was, in consequence, so much beloved. Another strong characteristic was his extraordinary generosity in regard to the work of others in the same field—also a sure, but none too common, indication of real greatness. These splendid features were borne early testimony to by his Cambridge tutor when Thomson became second wrangler and first Smith's Prizeman. A notable example of this occurred when an international memorial was proposed to commemorate the conception and extension of submarine telegraphy. On that occasion he was all for acknowledging and bringing to the front the Atlantic Cable work of Sir Charles Bright, in particular, whilst forgetting his own giant accomplishments in the same field.

The first few chapters of this fascinating memoir deal fully with Lord Kelvin's Scotch-Irish parentage and early boyhood. The son of James Thomson—originally a farm labourer, but ultimately a Professor of Mathematics at Glasgow University—the subject of the biography was born at Belfast on June 26th, 1824. Such was his early zeal for science that when still a school boy—taken for a while to Germany to study German—William Thomson would surreptitiously retire to the cellar of the house he was in for the purpose of studying Fourier. True to his race, William Thomson was an eminently worthy and careful young man, with a strong sense of filial duty. His letters to his father when an undergraduate at Cambridge testify to this. The necessity of economy had been constantly impressed upon him, and with good effect. Thomson may fitly be described as a good all-round man. Notwithstanding his early zeal for work, he was at no time a mere "smug." Thus, whilst at Cambridge he rowed in the Peterhouse boat, and also won the Colquhoun Sculls.

The biography recounts how, after leaving Cambridge, Thomson was sent to Paris for scientific research and laboratory work. A little later he became a Peterhouse scholar, and after taking pupils for a short time, was subsequently appointed to the chair of Natural Philosophy at Glasgow University. The young professor could at no time be described as a good lecturer, but he soon made his mark, if only on account of his strikingly enthusiastic personality.

While still quite young, Thomson contributed several highly important papers to the Royal Society at Edinburgh and London, and also to the British Association.

The biography traces, very interestingly and fully, Prof. Thomson's early connection with the development of the electric telegraph. The juvenile professor first turned his attention to the transmission of electrical signals through conducting wires, and these investigations culminated in his introducing the famous "Law of Squares" which became so important a factor in the design of insulated conductors, and in their resultant commercial value. These researches were made at the time that the Atlantic cable was being first talked of; and a little later Thomson became a director of the Atlantic Telegraph Co., representing the Glasgow shareholders in that capacity. Unfortunately, he only acted in an advisory capacity over this first enterprise, the responsible electrician being Dr. Wildman Whitehouse. The biography deals fully with the dispute between Whitehouse and Thomson regarding the electrical working of the cable, which serves as a noteworthy instance of Thomson's generosity and consideration for others. Certainly where satisfactory results were obtained it was only by Thomson's advice being followed, or his actual apparatus employed. In the subsequent trans-Atlantic cables of 1865 and 1866, the Professor had a free hand in the electrical department, the result being all that could be desired. He had, meanwhile, shown that ordinary receiving instruments could only give fresh signals after being almost perfectly relieved from the residual effects of previous operations. He had also taken out several patents—some jointly with Cromwell Varley, others with Fleeming Jenkin—for working through long insulated wires by improved apparatus; and these various instruments were turned to such good effect on the new cables that the speed of signalling was more than doubled. It was in connection with the Atlantic Cable expedition of 1866 that Thomson was "knighted" as electrician to the enterprise.

The biography next gives some interesting and amusing

reminiscences in regard to the preparation of the famous "Treatise on Natural Philosophy," over which Thomson joined hands with the late Prof. P. G. Tait, the volumes being more commonly known in after years as "Thomson and Tait."

A certain proportion of the memoir deals with life spent on board the great man's steam yacht—the *Lalla Rookh*—acquired in 1872. Perhaps on account of being unable to take much exercise in the country, owing to the curling accident he experienced in 1860 (which lamed him for life), Thomson became deeply attached to yachting. On the *Lalla Rookh* he would gather relatives and friends around him; and, failing them, he took his secretary, that he might the better get up-to-date with correspondence as well as with much mathematical and scientific research. It may be remarked here that throughout his life Thomson kept up a regular fusillade of correspondence on technical matters with various co-operators and friends—such as Joule, Stokes, Helmholtz, Clerk Maxwell, Lord Rayleigh, and his engineer brother, James Thomson, to clear up points and so forth. The *Lalla Rookh* was, as a matter of fact, first turned to account for experiments with the pianoforte wire deep-sea sounding machine, which he devised in the early seventies. It was whilst on one of these expeditions round about Madeira in 1873 that Thomson met Miss Blandy (the present Lady Kelvin) to whom he became engaged a little later, and who became his second wife. The biography tells how this attachment originated with the exchange of signals by means of lamps worked by the Morse code, reciprocated on shore by the waving of a lady's handkerchief.

The biography also deals with Thomson's life at his Ayrshire home (Netherhall), in the design and building of which the great man took quite an active part. It was here that Thomson sought many a quiet time when his yachting days were over; it was also the scene of extensive hospitalities.

At the period of his second marriage—his first wife (a cousin) having lived but a comparatively short time—the subject of the biography was about 50 years old, and had acquired considerable wealth from his inventions, in addition to his academic and consulting work. As time went on the great man's professional engagements increased at such a rate that he found less time for what was really nearest to his heart, viz., the field of original research, to be recounted afterwards in mathematical and physical papers. He had been in partnership for some 12 years with Cromwell Varley and Fleeming Jenkin over their individual and united patents for cable-signalling apparatus, and their various inventions had proved highly profitable—Thomson's mirror galvanometer, the quadrant electrometer, and the siphon recorder alone bringing some £65,000 a year in royalties from the different cable companies. As an example of his high sense of duty and regard for his seat of learning, it may be mentioned that when Sir William received the first large royalty on his siphon recorder, he devoted £1,000 of this to Glasgow University. The latter invention was patented in 1867, but required nearly three years of incessant work before it was brought into satisfactory shape, the ultimate result being that it is now used at every cable station, except where the same inventor's mirror apparatus sufficiently serves the purpose.

Equal in importance with his inventions in the field of electric telegraphy were Thomson's contributions to the science and practice of navigation—*i.e.*, his improved mariner's compass (1876) and his sounding apparatus (1872) already alluded to. Both of these were ultimately subjects of considerable profit; but it took a long time for either to become adopted—official lethargy and conservatism being peculiarly to the fore in the first case.

The biography tells us how dynamo-electric generators claimed the great man's attention from 1881 to 1884, but with no very important result. Much success, however, followed his researches in instruments for measuring electric currents and pressures. Yet this was not without immense labour, for Thomson spent days in "thinking in steel and brass," whilst innumerable changes were effected before finality in commercial form was reached. Sir William signified his interest in electric lighting enterprise by acting as honorary consultant to the company concerned with Mr. (now Sir Joseph) Swan's glow lamps. His house in Scotland and the *Lalla Rookh* were amongst the earliest to be lighted by these lamps, Sir William seeing to most of the details himself, and devising many of the switches, fuses, suspenders and such like.

The memoir next brings us to the year 1881, when Sir William Thomson began to be closely interested in the question of electrical transmission at a distance. Subsequently, he served as President of the Consulting Commission appointed by the New York Cataract Co. to consider the best means of utilising the Niagara Falls. Sir William was throughout entirely opposed to the use of alternating currents in any shape, but was in a hopeless minority, and in this case proved to be wrong in the long run. It was then that Thomson enunciated his now famous law that for economy in long-distance transmission of power at a given voltage the best economy is obtained when the conductor is of such thickness that the interest on the capital expenditure on the copper is equal to the annual cost of the energy lost in transmission through the conductor.

In politics Thomson, at first a Liberal, became a Liberal Unionist, when that party was formed; he was, in fact, a warm anti-Home Ruler. Thus, when the rejection of the Home Rule Bill was followed by a General Election, Sir William threw himself into the thick of the fray, speaking and presiding at meetings for several weeks. The biography mentions that Lord Kelvin was much in favour of Tariff Reform, and was enthusiastic on the subject of a vast Empire knit together for all purposes of mutual support.

Thomson's incessant scientific work did not prevent him from keeping in close touch with those of his relatives and friends at a distance. He was, in fact, a pattern of domesticity of the most charming description, and would write many an attentive and inquiring letter to those who were dear to him. His greed for music was such that when a good opera company visited Glasgow he would actually tear himself away from work the moment his lectures were over in order that he might be present and in good time.

On New Year's Day, 1892, Thomson was raised to the Peerage and became Baron Kelvin of Largs, with a seat in the House of Lords. A few months afterwards Lord Kelvin had occasion to make certain alterations in the construction of his astatic galvanometer, a description of which was thereupon published, with the result that a foreign electrician wrote to inquire who this Kelvin was who appeared to be claiming to have invented the galvanometer, that all the world knew Sir William Thomson was really the inventor of!

June 15th, 16th and 17th, 1896, celebrated Lord Kelvin's jubilee on his tenure of the chair of Natural Philosophy at Glasgow University for 50 years. From Prof. Thompson's memoir, it will be seen that the festivities were many and brilliant, both by day and night. Innumerable addresses were presented to his Lordship from all quarters of the globe, and many were the diplomas showered on him.

In the course of his speeches in acknowledgment of the celebrations, Lord Kelvin took occasion to express his deep regret that he "knew no more of electromagnetic force or of the relation between ether, electricity and ponderable matter than 50 years ago in my first session as professor." The biography tells us how three years later—when he had reached his seventy-fifth year—Lord Kelvin officially retired from the duties of his professorship. It seems, however, that the tie was not entirely severed, for, in resigning, he insisted on inscribing his name on the University roll as a "research student."

A little later Her Majesty Queen Victoria conferred on Lord Kelvin the Grand Cross of the Royal Victorian Order. Again, in 1902, Lord Kelvin was sworn a Privy Councillor on the occasion of the then approaching Coronation of the late King Edward. His Majesty also decided to institute a new distinction, the Order of Merit; the number of members was to be limited to 24, and Lord Kelvin was elected as one of the 12 civilians.

Besides being an eminently good man, Lord Kelvin was a remarkable contradiction to the mistaken notion that a scientific man must perforce be anti-Christian. He was, in fact, a thoroughly religious man in the best sense, and a devout member of the Church of England.

An enthusiastic opponent to Darwin's views, he took every opportunity to point to the utterly unscientific nature of disbelief in Divine revelation and design. "Evolution," he declared, "could not explain the great mystery of Nature and Creation." Lord Kelvin had a whole-hearted detestation of spiritualism and anything of that sort. He would often go out of his way to denounce that "wretched superstition," as he termed it. He, indeed, strongly objected to any physical phenomena being described as mysterious, and used to say, "When you call a thing mysterious, all that it means is that you don't understand it."

In 1907—the year of his death—Lord Kelvin consented to become President for the coming session of the Institution of Electrical Engineers for the third time. As it happened, he was never able to attend even the opening meeting, owing, in the first place, to the continued ill-health of Lady Kelvin, and in the second, to his own—ultimately fatal—illness. Prof. Thompson tells how, towards the end of 1907, Lord Kelvin caught a chill, which culminated in his retiring to bed with a severe attack of sickness. A little later symptoms of septic fever developed, under which he sank, passing peacefully away on December 17th, 1907.

A universal feeling manifested itself that Lord Kelvin should be interred in Westminster Abbey, and there he was buried alongside the remains of Sir Isaac Newton, the grave being indicated by a simple flat slab. The funeral ceremony was attended by every branch of pure and applied science, whilst King Edward and other members of the Royal Family were also represented. The service was one of the most impressive ever witnessed, the twelve pall-bearers representing not only the leading scientific societies, with which Lord Kelvin had been so prominently connected, but also H.M. Government, and the Royal Navy.

Prof. Thompson's volumes contain an unusually good proportion of wit and humour, interspersed with a full supply of useful information regarding his Lordship's work. Altogether the memoir may be said to constitute the finest thing in biographies that has ever been compiled regarding a man of science.

In closing, we would very strongly recommend every electrical engineer to secure a copy of this admirable biography, and to read every word of it.

PROCEEDINGS OF INSTITUTIONS.

Modern Electrical Dock Equipment.

By W. DIXON and G. H. BAXTER.

(*Abstract of paper read before the* INSTITUTION OF MECHANICAL ENGINEERS, *January 20th*, 1911.)

(*Concluded from page* 201.)

Where end-wagons are employed, turntables are necessary to ensure that the wagons are run on to the hoist with the end doors in the correct position for tipping. It was decided to make the turntables of the tipping type, so that the wagons can be run direct on to the hoist without the aid of a capstan. For operating the turntables two motors are provided, one for turning and one for tipping. With a maximum load of 32 tons, the turntables revolve at the rate of 300° in 15 seconds, and a similar load can be tipped the maximum height of 14 in. in 6 seconds, lighter loads being dealt with at proportionately greater speeds.

At present there are 18 4-ton travelling jib-cranes. A general view of one of these cranes is shown in fig. 4. The total range of lift is 80 ft., and the radius of lifting rope is variable from 20 ft. to 45 ft. The lifting speed with a load of 4 tons is 120 ft., and the speed of slueing at hook with maximum radius and maximum load 300 ft. per minute. The carriage is constructed with an archway, having a vertical height of 15 ft., and sufficiently wide for the passage of locomotives.

A capstan of the authors' own design, now known as the "Clyde" capstan, was erected at one of the Trustees' Docks as an experiment, the principal features of this capstan being that the head is not fixed to the spindle in the ordinary way, but is revolved by a clutch sliding on the upper end of the spindle inside the capstan head. The capstan is operated either by a single removable handle or by one handle and a foot pedal. By having the head loose on the spindle, a wire-rope fixed to the head can be used and a positive pull obtained as soon as the head begins to revolve, thus avoiding the heavy power losses incurred, more especially in hydraulic capstans, when they are revolved without doing work. Moreover, the rope being fixed, there is no slipping and grinding-away action, as in the case of capstans where hemp ropes are used; consequently the head will last as long as the rest of the capstan without repair or renewal.

Comparative trials made with the fixed-rope capstan, and with an ordinary hydraulic capstan, showed that, even assuming the hydraulic capstan had a positive pull, that is, with the rope fixed on the capstan head, the efficiency with gross loads of from 12½ to 50 tons varied from 10·17 to 32 per cent., and with the "Clyde" capstan for the same loads, the efficiency varied from 42 to 78 per cent. The ordinary capstan with fixed head and loose rope makes an average of 3·63 revolutions for 1 revolution of the "Clyde" type of capstan, when working under identical conditions. An ordinary electric capstan of the best modern type was put down in close proximity to the "Clyde" capstan, and records taken indicate that not only is there an economy in the consumption of energy, amounting to not less than 25 per cent., but the maximum demand on the generating station is 50 per cent. less in the case of "Clyde"

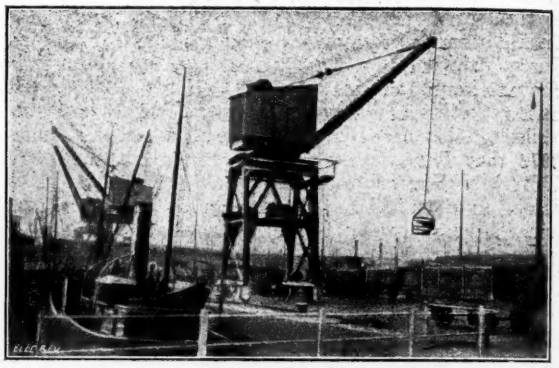


FIG. 4.—TRAVELLING JIB-CRANES.

capstans as compared with other types. The electric capstan can also be overloaded to 25 or 50 per cent. over the maximum working load, while the maximum load of the hydraulic capstan is limited by the working pressure.

Owing to the fewer revolutions run, the wear and tear of gearing is much reduced. A large saving in cost of ropes is effected, this really being the principal object for which it was designed; the annual cost of hemp ropes for ordinary capstans is almost £15, while that for the "Clyde" type may be taken at about £1. As a result of these comparative trials, 30 "Clyde" capstans were

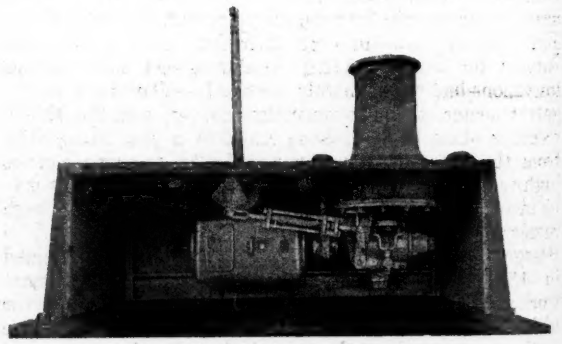


FIG. 5.—INTERIOR OF "CLYDE" CAPSTAN.

adopted at the Rothesay Docks, where nine of the ordinary type were already working. The working results of both the ordinary and the "Clyde" capstans have been so satisfactory that it may be claimed that the troubles hitherto connected with capstans have now been entirely eliminated. Fig. 5 shows the internal arrangement of the "Clyde" capstan.

The dock is lighted throughout by means of arc lamps arranged on wooden poles with an extension structure of wrought-iron. The installation consists of 91 lamps, which are arranged in suitable circuits controlled from the generating station.

A tunnel originally intended for water-pipes, running parallel with the quays and extending their whole length, being available, it was decided that the mains should consist of bare copper strips supported on insulators.

The total length of the subway is approximately 1¼ miles, the greatest distance from the station being ¾ of a mile, and the total length of bare copper strip employed is equivalent to 8¼ miles of single strip. The connections to crane boxes, capstans, &c., are made by bolting a cable lug on the distributor, from which the cables are laid on the solid system. The results of working have been such as to prove that the system is flexible, reliable and comparatively cheap, the saving effected in this instance being several thousands of pounds. No fault in the tunnel or on the solid system

of sufficient magnitude to cause a stoppage has occurred since the commencement of working.

There is every reason to anticipate that, with the dock completed and working at full capacity, when the annual consumption will be approximately 1,500,000 units, the total cost to produce this amount of energy, including works costs and capital charges, will be under the estimated figure of 0·94d. per unit. The actual works costs are, on an average, with a consumption of approximately 560,000 units per annum, approximately 0·89d. per unit. The capital charges at present increase the above figure to approximately 2d. per unit, but in the incompleted state of the dock these capital charges are out of all proportion.

At Rothesay Dock, where electric power alone is available, and where coal-hoists, cranes, capstans, turntables, and other machinery are in constant operation, no stoppage, due to electrical causes, has occurred to interrupt the regular working of the dock.

The authors submit that they have by this entirely electrically-equipped dock shown that, apart from the admitted advantages of electric power, the relative position of electric and hydraulic power is now :—

1. Electric and hydraulic systems are equally reliable.
2. The cost of working with electric and hydraulic power is equal at full load, but under variable and low load conditions, electric power is cheaper.
3. Electric power has now the equivalent of the hydraulic accumulator.
4. Electric power can be applied to all dock appliances, and has greater flexibility than hydraulic power.

Electric Heating as Applied to Cooking Apparatus.

By Harold Gray, A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers *at Manchester, January 17th*, 1911.)

The operators in the domestic field are generally unskilled in the engineering sense, often careless, and with small elasticity of mind, so that all apparatus passing through their hands must be of the simplest possible character combined with great robustness.

A breakdown or failure to do its work in any piece of electrical cooking apparatus under ordinary treatment should be rendered practically impossible. An electrical breakdown generally means connection to earth, *i.e.*, the shell of the apparatus becomes charged unless the shell is connected to an earth wire. A shock is probably the result, which may so alarm the operator that she will decline to have anything further to do with electrical cooking. For this reason all apparatus should either be connected to an earth wire or rest on an earthed metal table.

Electrical cooking has to compete against gas cooking. Assuming gas to be 2s. 6d. per 1,000 cb. ft., and that it gives out 600 B.TH.U. per cubic foot, and that electricity is ¾d. per unit and gives out 3,400 B.TH.U. per kilowatt-hour, then gas gives 20,000 B.TH.U. for 1d., and electricity 4,532 for 1d. Thus four times more crude heat is available for a given price with gas than with electricity. Under these circumstances the highest possible efficiency must be obtained from electrical cooking apparatus.

In considering the question of efficiency, it is necessary to split up cooking work into two broad classes, viz. :—

A.—Boiling, frying, &c., in which the basis is the transmission of heat to a liquid such as water or fat, which may, in turn, heat some other food.

B.—Roasting, baking, &c., which is carried out in ovens, and in which the basis is the application of heat energy to air, which passes heat on to the food to be cooked.

In arriving at efficiencies in Class A, the author has taken the basis as the evaporation of 1 lb. of water from and at 212° F. In efficiency tests, the actual raising in temperature of the vessels and liquid to 212° F. has been eliminated. As the result of careful tests, he finds that, at 2s. 6d. per 1,000 ft., the average cost of gas per pound of water evaporated from and at 212° F., is 0·131d. The gas cost to raise 1 lb. of water from cold (62° F.) to boiling and to evaporate this off, is 0·156d.

Coming to the efficiency of electrical cooking apparatus under Class A, the apparatus has not yet settled down to any standard design, in some cases hot plates being used with ordinary flat-bottomed vessels, and in other cases self-contained electrical vessels, while occasionally a combination of hot plates and self-contained vessels is employed. Table I gives the average of tests of the cost in pence per lb. of water evaporated from and at 212° F. under similar conditions to the gas tests, taking the price of electrical energy as ¾d. per unit, and the theoretical efficiency as 0·284 unit per lb. No account is taken in this table of the heat required to raise water or apparatus up to 212° F. In all cases it was found that the fastest heating speed obtainable was the most efficient one.

TABLE I.

Class of vessel.	Units / Lb. water	Pence / Lb. water	Efficiency.
Self-contained 1-pint saucepan...	0·312	0·234	91·0
Self-contained 3-quart water boiler	0·348	0·261	81·6
Frying-pan (aluminium) ...	0·379	0·284	75·0
Flat-bottomed aluminium 2-quart saucepan on hot-plate... ...	0·435	0·326	65·2
Flat-bottomed earthenware pot on hot-plate	0·455	0·341	62·4

Table II gives the cost of raising 1 lb. of water with identical apparatus from 61° F. to 212° F., which is of use when considering quick heating up in contradistinction to long-hour work. The hot-plate tests started from cold.

TABLE II.

Class of vessel.	Units / Lb. water	Pence / Lb. water
Self-contained 1-pint saucepan ...	0·055	0·041
Self-contained 3-quart water boiler...	0·061	0·045
Frying-pan (aluminium)	0·080	0·060
Aluminium saucepan on hot plate ...	0·124	0·093
Flat earthenware pot on hot plate ...	0·133	0·100

TABLE III.

—	Size of oven, cb. in.	Weight of bread.	Time.	Energy used.	Pence / Lb. bread
		Lb.	Min.		
Gas ...	6,400	8	58	31 ft.	0·116d. at 2s. 6d
Electricity	6,137	9	52	0·92 unit	0·076d. at ¾d.

Taking the best figures in the last columns of the tables, the cost to raise 1 lb. of water from cold to boiling and evaporate it is 0·275d. per lb. The result of the vessel giving the highest efficiency is taken, as this is the one which is the nearest to the gas-test conditions—*i.e.*, it is dealing with its full capacity of water.

From Table I it is seen that the efficiency is with the self-contained vessels very satisfactory ; in fact, very little can be done to improve this. The hot-plate efficiency is considerably less, but other considerations are involved in the use of the hot-plate system, which are dealt with later.

The obtaining of the efficiency of ovens is a much more difficult matter than that of the cooking apparatus in Class A. The autho has been forced to resort to the test of the actual quantity of energy required to cook a given weight of food, and has taken white bread as the standard.

The figure for the cost of electricity per pound of bread is the average of seven tests taken over a lengthened period. The figure for gas is the average of four tests. The tests were started at an average of 380° F. and finished at an average of 350° F. The heating-up from cold is not included, as for such a short cooking period the energy required to heat up is an abnormal percentage of the total.

It will be seen that the electrically cooked bread takes a shorter period to cook than that done in the gas stove, due to the more uniform heat in the electric oven, the door not having to be opened so often. The cooking in the gas oven in these tests was not of a satisfactory nature.

It will be seen that with the small cooking vessels gas is cheaper than electricity at the prices named, but with ovens there is a great advantage lying with electricity. The total amount of energy taken by the small pots and pans in working practice is only a small proportion of the energy taken in oven work, varying from 25 to 35 per cent., so that in general practice there is little reason to doubt that for overall economy electricity can and does compete with gas in price if suitable apparatus is forthcoming.

As to appliances themselves, the chief rivalry is going on between the "hot-plate" system and the "self-contained" system. In the former, one or more single or variable-speed hot plates are used in connection with ordinary cooking vessels, care being taken that the bottoms of the vessels are as flat as it is possible to get them. The hot plates, not having to be moved, can be connected to the supply by metal-sheathed wire and efficiently earthed, and there is no risk of shock to the operator. The cost of the hot-plate system is less than the self-contained one, and the simplicity of operation is much improved. The principal objection is the low efficiency.

In the self-contained system each vessel has its own electrical heating gear, generally with three or four different heats controlled on the series-parallel system by means of three plugs and contact pins. No attempt is yet made by the generality of makers to earth the appliances. When this is done an additional flexible wire has to be run from the vessel to the main earthing-point, making three wires per vessel as a minimum. The use of flexibles and plugs is a somewhat objectionable feature of this system. It has, however, the advantage of portability—*i.e.*, the vessel can be moved easily and heated up anywhere in the house where there is a supply—and it is much less cumbersome in this respect than the hot-plate system.

The great advantage of the self-contained system is in respect of its high efficiency ; the higher the price of energy is, the more necessary it is to adopt this system. The reliability of the electrical part of the vessels has much improved during the past 18 months, and there is now little risk of burning these out, except through excessive carelessness. The materials employed and the difficulty of efficient cleaning in vessels made by some makers are not above criticism. The author recently examined a series of vessels marketed by a manufacturer in which the electrical parts were

excellent. The vessels, however, were constructed with a brass bottom and copper sides, the brass being soldered to the copper. The vessels were lightly silver plated, which plating all worked off after one or two scourings. A sharp right-angle bend between the sides and the bottom added to the difficulty of cleaning. Metallic poisoning is the inevitable result of such construction.

Solid-pressed aluminium appears to be a good all-round metal if kept thoroughly clean, its only disadvantages being that it does not attain such a bright lustre as copper or brass. Cast aluminium is objectionable as it is liable to be porous, and hence dirt lodges in the pores.

The most important piece of cooking apparatus in general use and the one which is most difficult to make satisfactory in operation is the cooking oven. The average temperature of oven cooking is about 350° F., varying from 250 to 400 for various applications. This temperature of 350° should be attained from cold, say, 60° F., in about 15 minutes. This high speed of heating up is not only a convenience but also an economy, as the "idle period" radiation losses are reduced thereby; it involves a heavy demand on the supply mains, an oven of a cubical contents of 3·55 ft. requiring 3 KW.

The heat energy applied inside an oven is utilised in three ways:—

(*a*) In converting the crude food into the finished article.

(*b*) Loss due to radiation.

(*c*) Loss due to hot air escaping, principally experienced when the door is opened.

The third is generally by far the biggest percentage loss, and if the oven can be arranged so that the door is practically never opened except when the food is put in or taken out, great economy in heat energy is effected. Success depends on two things—viz., uniform heat throughout the cooking area, and a steady movement of the hot-air currents in the correct directions, to avoid "air-locks" over and around the food. If these two factors are in operation the cooking is perfectly uniform throughout the oven, the food does not require to be moved periodically, and hence the oven door does not need to be opened unduly. If the door is not to be opened for inspection it is, of course, essential that there be a light inside and an inspection window. A thermometer is also a practical necessity, as with a well-lagged oven it is impossible to estimate the temperature inside by feeling any external part.

To attain a practically uniform heat around all parts of the food, particularly in big ovens, presents some difficulties. The arrangement eventually adopted by the writer was to generate the heat at the bottom and deliver it into vertical "flues," which pass it into the oven proper at the top. The hot air is then forced from the top by fresh hot air continually rising in the flues, through all the area containing food, to the bottom, where it again comes in contact with the heating elements. Fig. 1 shows the direction of the air currents. The circulation of air from top to bottom is absolutely certain as long as heat is being generated.

With regard to retaining the heat in the general body of the oven, the general practice is now to have the oven double-jacketed with the hollow walls filled with dry air retained in a cellular state by means of finely-divided asbestos or slag wool. Both of these materials give excellent results if the jacket is made 1½ in. to 2 in. thick.

The electrical gear has in the past been one of the weakest details in oven work. The heating elements should be connected directly to the switchgear, but this is seldom done, a number of small nuts and bolts being very often employed to make the connections which, in the high temperature and with "sweating" occurring in cooling down, are very liable eventually to give trouble.

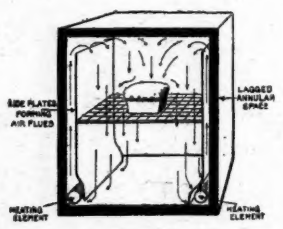


FIG. 1.

The switchgear itself should be simple and unbreakable. The use of tumbler switches, although the cheapest arrangement, is to be deprecated, as with the heavy currents required they may burn out very quickly in unskilled hands. A small controller operated by one handle appears to give the best results, and only two heating speeds—"fast" and "slow," and "off"—are really necessary.

There is no doubt that well-designed electrical ovens give vastly improved results over gas and coal ovens. Uniform heat, which means an increased cooking speed, a pure internal atmosphere, and simplicity of control, ensure the user never reverting to the old style provided the cost per unit is reasonable.

The author has found a combination of hot-plate and self-contained apparatus, together with an independent oven, to give the most satisfactory results. In combination with the above is arranged a "distributor" for the purpose of conveying power in a neat way to the apparatus. When any vessel is out of use its flexible wires run away—being operated on the telephone jack principle—and leave the cooking table clear. When in use the wires run direct to their respective vessels without any "snaking." A fuse and switch control each way and a D.P. fuse controls the whole distributor.

A hot plate with a graded regulator to turn its power down from full to $\frac{1}{10}$ full (say, 80 watts), would be a very valuable piece of cooking apparatus. So small a power as 50 watts will maintain a pint of soup at 120° F. To overcome this "turn-down" difficulty the author uses a hot-water boiler with a three-speed standard heater, fixed in a permanent position and connected in series with one of the "ways" on the distributor. If a three-speed series-parallel vessel is put on the "way" in series with the water boiler, 12 heating speeds can be obtained, and every watt of power not used on the cooking vessels is employed in heating water, so much of which is required in domestic work.

The high cost of good electrical cooking appliances is a source of complaint in many quarters. Reliability has been attained, and design is rapidly improving. Large outputs only are now required to reduce prices very considerably.

The price per unit at which power can be obtained for domestic uses will ultimately be the most important factor. Two public authorities already supply at ½d. per unit. A considerable number charge 1d., and the range of prices in the future is likely to be generally between these two figures.

A charge of over 1d. per unit will generally confine the use of electrical cooking gear to well-to-do people with whom the somewhat increased cost over gas or coal is negligible compared with the advantages obtainable.

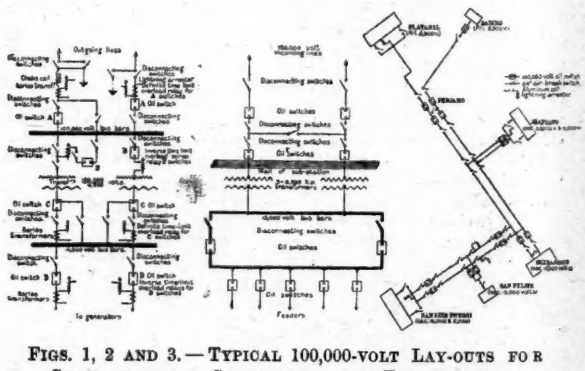
The amount of power and heat which houses can absorb must be throughout the country more than that taken in industrial works, and an enormous field is open for development. It is a practical certainty that all cooking operations besides heating and motive power work in a house will eventually be done by the application of electrical power, the question "how long" depending on two main factors, viz., the supply authorities and the manufacturers.

Modern Long-Distance Transmission of Electrical Energy.

By WILLIAM T. TAYLOR, M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *London, January 26th*, 1911.)

As a notable example of long-distance transmission to a small consumer, the Central Mexico Light and Power Companies have recently constructed a steel tower line 78·5 miles for an operating voltage of 100,000 to the city of San Luis Potosi, which is approximately 200 miles from the nearest generating station, the maximum load at the present time at this receiving end being 1,200 KW. Before entering into the contract it was thoroughly worked out by the company's engineers in Mexico and in Colorado (Central Colorado Power Co.), who found that the proposition was a paying one. Of course, this was not the only thing the company had in



FIGS. 1, 2 AND 3.—TYPICAL 100,000-VOLT LAY-OUTS FOR GENERATING AND SUB-STATIONS AND TRANSMISSIONS.

view before going in for a concession and an expensive transmission line and sub-station; nevertheless, it was the only consumer at the time. Since then another receiving station has been developed at San Filipé.

As regards the transmission line only, there is much in favour of direct current. The drawback of the high-voltage D.C. system is the complication at the generating and receiving stations, otherwise it would probably become universal practice. Probably the day is near at hand when direct-current long-distance transmission systems will be made as simple as the present day high-voltage A.C. long-distance transmission plants.

Experience has shown that the weakest link in a long-distance transmission system is the line itself. Whatever the source of power may be, and however good the mechanical and electrical construction, the line will be subject to all sorts of accidents to which none of the apparatus and equipment on the system is liable. It is sometimes found that the increased cost of apparatus necessary for increasing the transmission voltage is not counterbalanced by the saving in copper, and even where the saving justifies a higher voltage it is important to inquire into the possibilities of trouble from the use of the latter.

As a transmission line has both resistance and reactance, the voltage at the receiving station will change with every variation of load, because a certain portion of the voltage at the generating station is absorbed in maintaining the current in the line, and as the current varies with the load, the voltage drop in the line will vary, and either the voltage at the generating station or that at

the receiving station must change. In practice it is always sought to keep the voltage at the receiving station as constant as possible, by changing the voltage at the generating station in proportion to the varying load, or by changing the power factor to compensate for the variations in the drop of voltage.

So far as further increase in voltage is concerned for transmission lines, it appears to be limited by the production of corona.

To reflect and check surges on transmission lines, choke coils have been used to some advantage for many years, their effect being measured by the value of inductance and insulation. The lightning arrester is advantageous to the protection of apparatus from surges when set correctly.

In the early days of long-distance transmission work the formulæ used for the calculation of line reactance, self-induction, capacity, regulation, and amount of copper necessary for a given drop, were very tedious. In fact, it is only within the last few years that transmission line calculation has been simplified, and applied by the transmission engineer to actual conditions.

On long-distance and important systems (such as 100,000 KW. at 135,000 volts, a condition to be expected in the near future), the author is of opinion that split conductors will be employed—that is, two or more conductors constituting each phase of the transmission system. These conductors will be supported on separate insulators throughout the entire length, and only connected in multiple by means of switches at such points on the line as will facilitate continuity of service. By such an arrangement the electrostatic capacity of the entire line would be increased and the inductive reactance decreased, and interruptions of service from any cause reduced to a minimum. The flexibility of the system would be the most reliable that could possibly be obtained, and under ordinary conditions of load the regulation of the system would be greatly improved. Although the arrangement of existing transmission lines, taking the largest and longest, are important and noteworthy, the author believes that the very near future will see developments where branch lines will be longer than the present longest main lines, and generating and receiving stations will be far larger than those in existence. The longer and more important transmission lines become, the nearer an approach will be made toward the arrangement of split conductors.

In the operation of transmission systems it is most important to keep good regulation. It is impossible to give satisfactory service unless the fluctuations of voltage can be kept within the limits of from 3 to 8 per cent., depending on the size and length of transmission system and the character of load. With large non-synchronous motors carrying unsteady loads, such as 5,000 to to 7,000 H.P. for rolling mills, and motors of 1,000 to 1,500 H.P. for hoisting purposes, it becomes a difficult problem to keep the voltage within any reasonable limit when this class of load is at the end of a line 200 miles from the nearest generating station, and when the units at the generating station are only of moderate size, say, 3,500 KW. A receiving station carrying a city lighting load and fed from the same transmission line will be greatly impaired if the fluctuations of voltage are above this value.

Many years of experience have shown that the design, installation, and correct location of switches for a generating station, transmission line, and receiving station have a very important bearing on the continuity of service of a large system. Lately practice has been diverted to outdoor installations of lightning arresters, entering buildings from the roof, and arranging high-voltage oil switches in steel tanks similar to high-voltage transformers, and operating them by primary relays, and using the high-voltage oil-switch bushing as the primary for series transformers, thereby cutting down the cost of series transformers by a considerable amount.

It is a well-known fact that to operate a long-distance transmission system requires considerable generator capacity, even at no load. The Southern Power Co., U.S.A., has a 7,000 K.V.A. load on its 100,000-volt lines when all the switches are open at the receiving ends.

Transformers at the generating stations are now usually arranged either in groups of three single-phase or one polyphase for each generator, no matter what the kilowatt rating of the transformer or transformers may be. One of the largest installations of this kind is three 6,000-KW. single-phase transformers with a 12,500-K.V.A. generator for the Mexican Light and Power Co.

For systems that have their generating stations and receiving stations scattered about in different directions, it is profitable, from the point of continuity of service, to build a double-circuit construction to each station (no matter what the character or magnitude of the load it may have at the time) with cross-over and sectionalising switches to be manipulated in case of trouble on any one line or for necessary repairs, &c., also on account of the possibility of future extensions.

As the price of wood is steadily increasing and the price of structural steel is decreasing, practice is steadily leaning toward steel towers and poles as substitutes for wooden poles and structures. Spans range from 300 ft. as a minimum to 750 ft. as a maximum. On straight-line construction, from eight to 12 towers are used per mile, the length of span increasing with the height of tower, and the height being measured from the ground stub-joint to the first line conductor, which is usually from 40 to 55 ft.

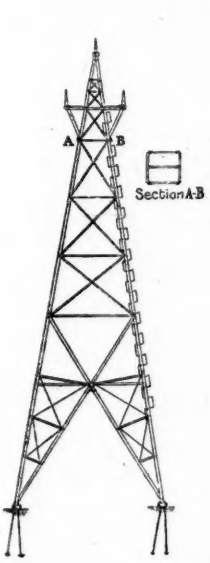


FIG. 4.—SINGLE-CIRCUIT TOWER.

FIG. 5.—DOUBLE-CIRCUIT TOWER.

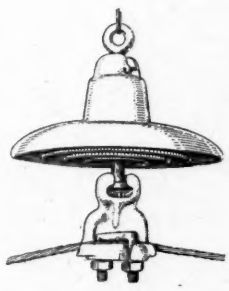


FIG. 6.—SHOWING SINGLE SECTION AND CLAMP.

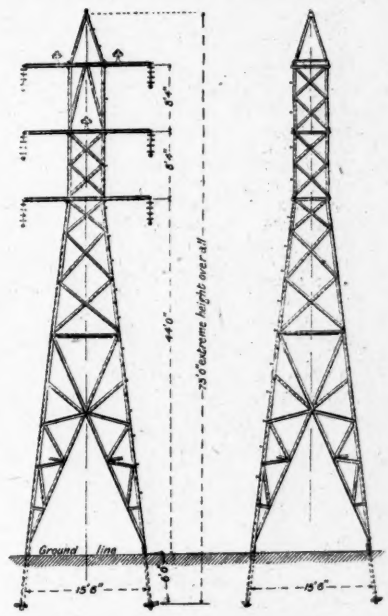


FIG. 7.—50,000-KW. 110,000-VOLT TOWER.

Most tower lines in operation at the present time are using overhead steel cable grounded at each tower. The steel cable is pulled up to the requisite tension and securely fastened by means of a clamp to the top of each tower. This gives a much greater ultimate strength and a much higher elastic limit than the line conductors, provides an overhead anchorage, enables the line conductors to be assembled with less rigidity, and permits the satisfactory use of a lighter tower. It has the further advantage of providing a means of protection of the line from lightning, and connects them so that all are at the same potential. This is a very essential factor on long lines, even when the current is off, so that work can be safely carried on without danger from shock.

Fig. 4 shows the assembly of a tower for the tin-type insulator. The arrangement of steps on the right side of the tower is now standard practice. Fig. 5 shows a general assembly of a 2-circuit tower with centrally located steel rod extending 36 in. above the topmost insulator to support the overhead ground cable. The life of a steel tower should not be less than 35 years when erected on a concrete foundation. The height of the lowest conductor from the ground line varies from 35 ft. as a minimum to 65 ft. maximum. The spacing of conductors varies from 3 ft. 6 in. for a 33,000-volt line to 10 ft. for a 110,000-volt line.

The life of a wooden pole depends on the character of the wood and the amount of air and moisture to which it is exposed, and ranges from five to 30 years, the average being about 12 years.

Poles from 35 to 60 ft. in length are extensively used for voltages ranging from 30,000 to 60,000, the lengths being increased to meet conditions over crossings, &c. The lowest conductor should never be less than 22 ft. from the ground. Poles above 40 ft. may be sawn off at the ground line upon decay, and let down into the ground about 5 ft., depending on the condition of the surrounding country. Each pole should be numbered from a certain definite

terminal or junction, and the number should be painted clearly on the pole at a distance of about 6 ft. from the ground line. Pole tops are cut wedge-shape at an angle of about 45°, and are sometimes trimmed to a conical shape. Protection by nailing a sheet of iron plate over the top of the pole is of questionable value. In general it is considered preferable to apply a liberal coating of white lead and linseed oil, or mineral paint.

Size alone will not produce efficiency in an insulator ; the amount of surface as compared with the weight of the mass bears a definite relation to its efficiency. Insulators should be designed to withstand extreme weather conditions. For high voltages, insulators are usually made in several pieces, held together by cement or glazed together while being fired in the kiln. The pin-type insulator for 60,000 volts is at its limit.

One of the most important improvements in recent years has been the development of the so-called suspension-type insulator for transmission lines. This type of insulator is usually installed from four to eight in series, depending on whether the voltage is 60,000 or 110,000 volts. They are hung directly from the cross-arms, are free to swing, and to allow for adjustment of conductors which are dead-ended at the strain insulators. The latter are about 1 mile apart, and at all angles on anchor towers.

For high-voltage transmission lines the suspension-type insulator supersedes the pin-type insulator, and at the present time is considered standard for lines operating at voltages above 60,000. It requires a higher tower, but the extra cost involved is offset by using less material for the cross-arms and the tops of towers.

Experience with the Guanajuato Power and Electric Co. and the Michoacan Power Co. (branch companies of the Central Mexico Light and Power Co.) shows that there is a great saving in favour of the suspension-type insulator, as shown in fig. 6. For 12 months' operation of 85 miles of line using the suspension-type insulators, and 110 miles of line using the pin-type insulator, careful records show a saving in insulators alone of 90 per cent. in favour of the former, or 10 per cent. of the maintenance cost of the line equipped with the pin-type insulator.

The method of construction of the suspension-type transmission is to place at regular intervals along the line, about a mile apart, extra strong towers where dead-end insulators can be installed, from which the conductors are drawn up and dead-ended. Between the dead-end towers, the conductors are hung loosely from each insulator—that is, loose enough to slip through in case of breakage.

Each part of this type of insulator must be designed to have a minimum electrostatic capacity. Tests at high voltage show that, the larger the electrostatic capacity of insulating parts in series the greater the liability of puncturing the end part (not middle units) when a surge occurs on the line.

The insulator used on the Central Mexico Light and Power Co.'s lines is of the suspension type, designed to get maximum arcing length efficiency. A 3-piece insulator of this type connected in series, has a dry flash-over of 220,000 volts, and a wet flash-over of 130,000 volts. The flash-over values of this insulator show about 12,750 volts per inch length of insulator under dry conditions, and about 7,600 volts per inch length of insulator under standard precipitation. A 3-piece insulator of this type is considered quite ample for a line operating at 60,000 volts, and a 6-unit insulator for 104,000 volts. The exact number of pieces per insulator will depend on the climatic conditions in the locality where the insulator is to be used.

The method of connecting the pieces together is by means of a ball and socket joint, the ball being locked into place by inserting a cotter-key into the socket just to meet the ball pin. This method of connection makes a convenient and flexible joint.

It is practically impossible to specify a standard arrangement for the installation of arresters for each particular system. At the present time there are to be found very long lines operating at 110,000 volts without lightning arresters. According to all reports, no trouble has been occasioned from lightning. A method of protection giving the most promise for long-distance lines is the overhead grounded wire, which, strung along the tops of towers, may be an important factor in the mechanical stability of the line, and in the case of lines over 100 miles long will probably save its cost by permitting a reduction in the weight of towers and their guys. A much more certain arrangement will be obtained by using two grounded wires, one on each side of the line.

In the choice of lightning arresters for high voltages and long-distance lines, there seems to be few to select from except the aluminium type, multi-gap type, and the water-jet. The type that has repeatedly demonstrated its value is the aluminium arrester.

One of the most important points to remember in the installation of lightning arresters is the ground connection. The one that appears to give the least trouble is a number of iron pipes in parallel driven into the ground thoroughly moistened with water. Ground connections for arresters should be as short and straight as possible from the arrester to earth.

As a rule, transmission lines are designed by working out the energy loss, the regulation, the cost of conductors, and the cost of towers for a given set of assumptions as to the voltage and size of conductor, and then finding the effect of varying one or the other quantity to see if better results can be obtained.

A long line such as the Cook Falls, designed for an operating voltage of 135,000, according to calculations made, will have leakage and corona losses amounting to 1 KW. per mile of line, and an apparent power approximating 11,000 K.V.A. for the first 125 miles. The 100,000-volt line of the Southern Power Co. is estimated to have an ultimate charging current of 20,000 K.V.A. Very careful study of all conditions covering first cost, operation and maintenance should be made before a final decision is arrived at as to the proper frequency, voltage and size of conductor, &c., of any given line.

Inductive reactance is, in the majority of cases, neutralised by the capacity effect of long transmission.

Assuming a 200-mile 110,000-volt line with conductors weighing 2,710 lb. per mile, the power loss when transmitting 20,000 KW. over the total length of line will be 11·6 per cent. From such a case it is evident that with copper selling at 8d. per lb., the investment in copper would be £54,200, and assuming that power can be sold at the rate of £3 per KW.-year, the cost of lost power would be £6,960 per year.

At the present time the electrical connections of transmission systems are about equally divided between the star connection with grounded neutral and the delta connection (non-grounded). When we carefully study the advantages and disadvantages of both the methods of connection (*i.e.*, delta-star to star-delta, and delta-delta to delta-delta, which are the two common high-voltage transmission connections in use at the present time), we find practically the same conditions are met with from the operating standpoint.

From the list of hydro-electric transmission systems (Table I) it will be seen that the majority are operating with the delta connection. For large units, such as are now being designed, it is important to use the delta connection on the high-voltage side, thus allowing for sufficient increase of power to keep the line loss and regulation to a given value by a change from delta to star. During the early part of 1910 a change from delta to star connection was made by a very large transmission system operating in Mexico. To make the change according to the plans submitted, it was necessary to redesign something like 60,000-KW. capacity of transformers originally designed for 60,000 volts (delta). The change from 60,000 volts delta connection to 85,000 volts star connection is undoubtedly a satisfactory one for the present load and the line insulators, the latter operating with less strain.

TABLE I.

System.	Kilowatt capacity.	Voltage.	Connection.	Phase.
Mexican Light & Power Co., Ltd.	6,000	85,000	star	1
Stanislaus Power Co. ...	3,750	138,500	star	1
	2,233	104,000	star	1
Great Western Power Co.	10,000	110,000	delta	3
	5,000	90,000	delta	1
Great Northern Power Co.	7,500	60,000	delta	3
Central Colorado Power Co.	3,330	100,000	delta	1
Southern Power Co. ...	3,000	100,000	delta	1
Hydro-Electric Power Co.	1,250	110,000	delta	1

The operation of long-distance transmission systems is a difficult proposition to manage, and is becoming more so as the transmission lines get longer and additional generating and receiving stations are put in parallel.

A system covering many hundreds of miles of transmission lines and many generating and receiving stations connected in parallel has a chief operating engineer, located near the centre of distribution or at one of the largest receiving stations. He is in constant touch with the construction of and additions to any part of the system. He advises the shutting-down or starting-up of generators, switching in or out of groups of transformers, closing or opening of switches on line sections, and control of all interruptions of service at the generating stations, the transmission lines, and the receiving stations with their auxiliary plants. At each receiving station a local superintendent is placed in charge of the business of the corporation. Each local manager is a technically trained man with a broad experience.

On long lines it is now common practice to build patrol and emergency houses for the patrol men. The patrol houses may be located 10 to 20 miles apart, depending on the roughness of the country. The emergency houses may be only large enough to contain material such as insulators, line conductors, and guy wire, tools, &c., for an ordinary breakdown ; they are usually located midway between two patrol houses.

For all long-distance systems independent telephone pole-lines between generating and receiving stations are recommended. An independent telephone system between the main generating station and the most important receiving stations is indispensable, especially when the chief operating engineer is located at one of these stations.

Telephone circuits strung below the main transmission line conductors are subject to constant trouble and danger, no matter how well the power transmission and telephone circuits are transposed, since an unbalancing of the power lines, or a ground on any one of the lines, will induce a voltage in the telephone circuits below, which is dangerous to any one using the telephone ; the linemen are subject to great danger because no indication is previously given them before connecting their portable instruments to the line. On all long lines with a telephone service on the main transmission towers, telephone transformers should be used.

The three tabulated statements shown in Tables II, III and IV, are representative of a large hydro-electric long-distance transmission system.

A large number of electric power companies have consolidated into one system. This is very marked in countries where water-power is plentiful, as, for instance, the Western States of America and Mexico. Some of these developments, which have made possible long-distance transmission and the paralleling of numerous steam, gas, and water-power plants scattered about within a radius

TABLE II.—Statement of General Expenditure on Various Parts of System.

System.	Capital amount.	Interest.	Depreciation.	Operation amount.	Total amount.
	£	£	£	£	£
Dams	900,000	45,000*	27,000†		72,000
Pipe-lines and tunnels	750,000	37,500*	37,500*		75,000
Power station equipment	370,000	18,500*	18,500*	15,000	52,000
Power station building	200,000	10,000*	6,000†		16,000
Transmission lines ...	560,000	28,000*	28,000*	12,000	68,000
Sub-station building	74,000	3,700*	3,700*	12,000	7,400
Sub-station equipment	120,000	6,000*	6,000*		24,000
Total sum ...	2,974,000	148,700	126,700	39,000	314,400

* At 5 per cent. † At 3 per cent.

TABLE III.—Statement of General Losses and Efficiency.

Parts of system.	*a.*	*b.*	*c.*	*d.*	*e.*	*f.*	*g.*
Per cent. losses ...	1·54	2·500	23·50	2·500	2·00	5·050	2·000
KW.-hour losses of each part	3·30	5·340	39·50	4·200	3·28	8·150	3·000
Efficiency of each unit	98·50	97·600	81·00	97·500	98·20	95·200	98·000
Total efficiency ...	—	96·200	77·80	75·800	74·50	71·000	69·500
Actual KW.-hours in millions	213·00	207·700	168·20	164·000	160·70	152·600	149·600
Resulting price per KW.-hour in pence	0·09	0·177	—	0·335	—	0·464	0·525

a = Dams. *b* = Pipe-lines and tunnels. *c* = Turbines and auxiliaries. *d* = Generators. *e* = Generating station transformers. *f* = Transmission line. *g* = Sub-station transformers.

TABLE IV.—Statement of Load Factor, Minimum Price of Energy, Weight of Copper, and Copper Losses.

A.	B.	C.	D.	E.	F.	G.	H.	I.	J.
0·5	1,210	71·00	9·75	163·95	154·30	5·94	1·13	0·450	279,400
0·7	1,425	83·50	15·30	230·90	215·60	6·62	1·07	0·326	280,240
0·9	1,590	93·20	21·60	29·00	273·40	7·32	1·02	0·261	280,500

A = load factor; B = weight of copper in tons; C = cross-section in millimetres; D = millions of kilowatt-hours lost on the line; E = millions of kilowatt-hours leaving the generating station; F = millions of kilowatt-hours entering the receiving station; G = average losses per cent.; H = form factor; I = price in pence per kilowatt-hour at the receiving station; J = price of energy in £ at the receiving station.

of from 20 to 200 miles, are an economical success in so far as being able to give any class of consumer cheaper power than it is possible for the individual plant to generate.

In the actual cost of hydro-electric power development there are so many variables for different systems as to make impossible anything like a standard cost per KW.-hour.

Rates for electric power are adjusted according to individual circumstances, influenced principally by capital charges, interest and depreciation, and operating costs. Thus, a consolidated system operating many generating and receiving stations scattered in different directions will necessarily have different rates for power purposes.

The present electric power rates on practically all hydro-electric systems of any importance and magnitude are based on a fixed charge per horse-power per month plus a definite amount per KW.-hour as recorded on the meter.

At the present time single-circuit transmission of electric energy has reached as high as from 25,000 to 50,000 KW. per tower line.

A transmission tower line is now being built to carry two three-phase circuits of 0·47 in. diameter copper conductors, one circuit on each side of the tower, and in a vertical plane suspended from the ends of the cross-arms, designed for 25,000 KW. at 110,000 volts, or 50,000 KW. for the three cross-arms, with a ground wire connected to the apex of the tower. The spacing of the suspension towers will be about 600 ft. with strain towers about every mile.

It is difficult to realise fully the vast amount of responsibility that rests upon the chief operating engineer in charge of such a transmission system. No matter what ingenious scheme is adopted to provide for perfect switching, an interruption of a circuit carrying 25,000 KW. will mean a comparatively long delay and probably a great loss of money.

The approximate costs of towers to carry 50,000 KW. at 110,000 volts are :—

Suspension type	£26 per tower.
Strain type	35 ,,
Flexible type	20 ,,

Fig. 7 shows the outline and dimensions of the tower of the suspension type.

This design of tower will permit a team of horses to pass underneath. The right-of-way man finds this a valuable feature to have when he is trying to get his right-of-way from landowners, as the actual space occupied by the tower amounts only to about 1 sq. ft. at each corner. It also enables a farmer to plant farm products inside of the tower with practically no loss of space.

THE RATING OF MACHINERY

[FROM OUR LEGAL CONTRIBUTOR.]

In the present state of party politics, when questions of grave national importance are occupying public interest, any measure which merely affects the interest of the few is not likely to engage the attention of the legislature. If a suggested alteration of the law is likely to affect the workers, to whose numerous votes the politician may look for support at the polls, it is more likely to find a place on the programme of business; but if it is the mere capitalist whose interests are at stake he may shift for himself.

The rating of machinery is a matter which primarily affects the capitalist, and that being so, he has to take such steps as may be necessary in his own protection. He must be prepared for emergencies; and to be so prepared is obviously the policy of the Machinery Users' Association, whose current prospectus has recently been supplied to us. In view of the enormously important work carried out by this body, it may be well to give some account of its objects, and the methods by which those most useful objects are obtained.

The point may be stated in a few words. The rateable value of machinery properly depends upon the rent for which the property might be expected to let from year to year, subject to certain deductions. A certain person named "the hypothetical tenant," is created, and the assessment committee has to ask itself—what would the hypothetical tenant pay for this property? 'Tis but human nature that the rating authority should try to enhance the value as much as possible. On the other hand, the owner naturally seeks to reduce it to the vanishing point. But what is to be taken into consideration for the purpose of ascertaining the value?

Owing to a decision of the Courts, which was arrived at many years ago, what is called "fixed machinery" in a mill or other premises may be taken into account. The principle was affirmed in 1905 in the case of Kirby *v.* Hunslet Union (22 T.L., R. 167), when it was declared that in assessing the value of the premises used as engineering works, the value of the user of machinery which is on the premises for the purpose of making the premises fit for engineering works, but which is not affixed to the freehold so as to form part thereof, is properly to be taken into account as enhancing the value of the premises.

In consequence of this decision numerous rating authorities throughout the country have placed a serious burden upon the English millowner, and the injustice of it is that his Scottish and Irish rival is exempt from this very considerable burden. To obtain equal justice for English manufacturers, the Machinery Users' Association has promoted, and will again promote, a Bill in Parliament, of which the operative part is as follows :—

"From and after the passing of this Act in estimating for the purpose of any valuation list, or poor or other local rate, the gross estimated rental or rateable value of any hereditament occupied for any trade, business, or manufacturing purposes, any increased value arising from machines, tools, or appliances which are not fixed or are only so fixed that they can be removed from their place without necessitating the removal of any part of the said hereditament, shall be excluded.

"Provided that the gross estimated rental of any such hereditament shall be estimated at not less than the sum at which it might reasonably be expected to let for the purpose for which it is used on a tenancy from year to year void of the machines, tools, and appliances which it might be reasonably expected would be supplied by the tenant, if the tenant paid all the usual tenant's usual rates and taxes and if the landlord undertook to bear the cost of repairs and insurance and the other expenses (if any) necessary to maintain the said hereditament in a state to comm nd such rent.

"Provided also that the terms, machines, tools, and appliances for the purposes of this Act shall not apply to any machinery, machine or plant, used in or on the hereditament for producing or transmitting first motive power, or for heating or lighting the said hereditament."

The reason why the rating authorities show no disposition to abandon a fruitful source of revenue is not far to seek. If they cannot get their funds from one source they must get them from another; and it is easier and less invidious from the point of view of the local politician to get it from a few wealthy manufacturers than from a number of dwellers in small houses. So long, however, as this burden imposed upon the manufacturer is kept up, so long will the cost of production be perceptibly and unfairly maintained.

As the Association point out in their prospectus :—"The rating of machinery is without a doubt an oppressive tax upon labour, an indirect fetter to the industry and commerce of the country, and highly injurious to the national interests; but in consequence of the influence and pressure that has been brought to bear by the Association, many cases of the wholesale rating of machinery have been abandoned."

Apart from the advantage to be gained by aiding in the passage of the Bill above referred to, membership of this body confers privileges of a more immediate character. Thus, members are entitled to the confidential reports of eminent specialists on rating, free of charge, proportionate travelling expenses excepted. Experts employed by the Association are continually visiting all parts of the country on this work, which is done quite privately and confidentially from every point of view. To use the words of the report :—"Members are not in the least committed to take any action after a report has been sent to them, if for any reason they think it undesirable. The rating and income-tax law and practice bristles with technicalities. These difficulties occur from the

first deposit of the valuation list, but this Association has become a wholesale check upon assessing authorities and their valuers, and upon the surveyors of taxes. Members should never agree to any proposed new assessment of their premises without first consulting the Association. Many old-standing assessments have been reduced after a judicious investigation of same by our experts. The success of the Association in Rating Appeals, and in its other work is ensured by (1) combinations of local interests; (2) the varied and extensive experience of experts gained in the last quarter of a century in all the industries and districts of the kingdom; (3) the care and skill with which its work is conducted; (4) the influence and capital of the Association."

Some of the actual victories won by the Association in the never-ending war between rating authorities and the ratepayer are also noted here. For instance, at the Conference of the 29 boroughs comprised in the County of London, and held at the offices of the County Council, to consider matters of assessment procedure and practice in connection with the quinquennial revaluation of London in 1910, it was resolved to put a tax of 7½ per cent. on the capital value of all machinery used in London. This policy was frustrated simply by complete readiness of the Association to act—instantly and strongly. The following is a typical case:—

A firm of colour printers obtained some new printing machines, whereupon the Assessment Committee promptly increased the assessment on the works. An appeal was made to quarter sessions, but before the appeal was heard the solicitor to the Assessment Committee informed the solicitor to the Machinery Users' Association that his Committee did not intend to defend the appeal, and consented to an order being made for the amendment of the rate, and the payment of the costs by the Assessment Committee. Finally, some little time ago there was formed the Rating and Assessing Authorities Defence Association, its objects being:—

1. To defeat the Bill in Parliament promoted by the Machinery Users' Association.

2. By combined action to defeat the Machinery Users' Association in the cases they take up locally. This is valuable evidence of the great value of the work of the Machinery Users' Association and of the respect entertained for it by the local rating authorities, but the Rating and Assessing Authorities Defence Association no longer exists while the Machinery Users' Association has doubled the number of its members and the strength of its financial resources. The prospectus also contains a caution to users of machinery which may well be studied by all those who are interested in this important subject.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

SWEDEN.—The Swedish Customs authorities are particularly strict as to the marking of imported goods. If such goods bear the name of a place, property, or industrial establishment or tradesman in Sweden, or any marking in the Swedish language to explain the nature of the goods—even consisting of a single word only—they must also bear the word "import," or the name and domicile of the foreign manufacturer, applied in a distinct or conspicuous manner, so that removal or effacement cannot be effected easily or without injury to the goods. Goods not so marked are liable to confiscation. Goods which are packed and imported in bulk, but can be sold singly, must themselves be properly marked so as to show their foreign origin; the fact that such marking may have been applied to the packing or covering in which the goods are imported will not of itself constitute a sufficient compliance with the Swedish regulations.

Invoices and consignment notes should state the gross weight of packages and the net weight of contents, which should be fully described, and the country of origin should be stated. Where various descriptions of merchandise are packed together, the net weight of each class should be stated separately. Invoices should be in duplicate.

The following are the duties at present leviable on electrical and similar goods imported into Sweden, but it should be noted that a new tariff will be put into force in Sweden on December 1st, 1911. Information as to the rates to be levied under this new tariff will be published in the ELECTRICAL REVIEW at a later date:—

	Kronor per kg.
Dynamo-electric machinery	15 % ad val.
Electric lamps	1·50
Copper sheets or plates:	
Rolled	·10
Hammered, trimmed with edges folded over, perforated, or otherwise manufactured ...	10 % ad val.
Copper wire:	
Twisted for cables or cordage, not insulated ...	·15
Covered with silk or other textile materials ...	1
Coated with india-rubber or gutta-percha, including electric light cables insulated in the same manner	Free.
Covered with lead or strengthened with iron, including electric light cables so covered or strengthened; also wire in combination with other materials	Free.
Otherwise insulated; also other electric light cables	10 % ad val.
Gilt or silvered	2·50
Other kinds...	·10
Copper or brass manufactures:	
Gilt or silvered	1·50
Nickelled, varnished, lacquered or otherwise coated	·75
Other kinds...	·50
Rails for railways, bedplates, fishplates and sleepers	Free.
Lamps, chandeliers, &c., of iron	·50
Iron wire, drawn, more than 10 mm. in diameter; also rolled wire not drawn	Per 100 kg. 2·50
Wire of iron or steel, other:	
Of a thickness or diameter of 1½ mm. or more...	4
" " " less than 1½ mm.	8
Wire of iron or steel covered with silk or other textile materials or with paper	Per kg. 1
Steam engines and boilers	10 % ad val.
Electric meters; surgical, physical, &c., instruments	" "
Railway and tramway carriages	15 % "
NOTE.—Vehicles fitted with a motor are dutiable at this rate.	
Glass globes for lamps	·60
Goods which cannot be classed under any other heading of the tariff:	
Raw	Free.
More or less wrought	15 % ad val.

NOTE.—The value on which *ad valorem* rates are calculated is the price paid for the goods, with the addition of cost of packages and the expenses incurred for insurance, freight, &c., up to arrival at the port of entry, or the price of the goods at the place of discharge for their further conveyance.

Kronor = 1s. 1¼d. Kilog. = 2·204 lb.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1909.

COMMUTATOR GRINDER FOR DYNAMOS AND MOTORS. L. Newitt. 28,340. December 4th.

ALTERNATING-CURRENT ELECTRIC SYSTEMS FOR DRIVING MULTIPHASE INDUCTION MOTORS AT DIFFERENT SPEEDS. H. A. Mavor, H. M. Hobart, and Mavor and Coulson, Ltd. 30,556. December 31st.

1910

CONDUCTORS SPECIALLY APPLICABLE TO HOLDERS FOR GLOW LAMPS FOR USE ON MOTOR-CARS AND OTHER PURPOSES. A. G. Benstead and L. Aron. 97. January 1st.

COMBINED ADJUSTABLE SUPPORT AND CONTACT DEVICE FOR ELECTRICALLY DRIVEN FANS. J. Bein. 212. January 4th.

ELECTRICAL TRANSMISSION AND RECEPTION OF SIGNALS, DRAWINGS, PHOTOGRAPHS AND THE LIKE. T. T. Baker. 361. January 6th. (Cognate application, No. 14,672 of 1910.)

PRIMARY GALVANIC BATTERIES. T. W. Byrne. 568. January 8th.

TIME-SWITCHES FOR CONTROLLING ELECTRIC CIRCUITS OR THE SUPPLY OF FLUIDS THROUGH PIPES. R. A. Venner and R. C. Griesbach. 1,296. January 18th.

APPARATUS FOR DISTRIBUTING ELECTRICITY. E. W. Lucas, E. W. Walmsley and J. T. Walmsley. 4,115. February 19th. (June 11th, 1910.)

ELECTRIC WELDING. S. Jevons and J. D. Green. 6,553. March 16th.

MEANS FOR AUTOMATICALLY VARYING THE POWER OF AN EXPLOSION MOTOR COMBINED WITH AN ELECTRIC MACHINE. S. Missotten. 9,222. April 16th.

MEANS FOR REGULATING THE ELECTRODES IN ELECTRIC SMELTING FURNACES. Aktiebolaget Elektrometall. 12,430. May 21st. (May 21st, 1909.)

ELECTRIC ARC LAMPS. Siemens-Schuckertwerke Ges. 12,483. May 21st. (May 24th, 1909.)

ELECTRIC FUSES. V. G. Middleton and C. J. Baker. 13,311. June 1st.

IGNITING APPLIANCE FOR LIGHTING CIGARS AND FOR OTHER PURPOSES. F. Koch. 14,859. June 21st.

APPARATUS FOR COATING MOULDS FOR ELECTROTYPING AND THE LIKE. A. W. Penrose & Co. (G. Benedict, U.S.) 16,709. July 13th.

MOTOR-CONTROLLING CIRCUITS. Adams Manufacturing Co. (Cutler-Hammer Manufacturing Co.) 17,341. July 20th.

ELECTRICAL FUSES. Siemens-Schuckertwerke Ges. 18,528. August 5th. (August 11th, 1909.)

SYSTEM OF CONTROL AND APPARATUS FOR INDICATING ELECTRIC CALLS. L. Viette. 18,678. August 8th. (October 19th, 1909.)

IGNITION IN LARGE INTERNAL-COMBUSTION ENGINES. Firm of Robert Bosch. 19,242. August 16th. (April 6th, 1910.)

CONTACT BREAKER FOR MAGNETO-ELECTRIC SPARKING APPARATUS FOR INTERNAL-COMBUSTION ENGINES. Firm of Unterberg & Halmle. 22,040. September 20th. (October 11th, 1909. Addition to No. 4,030 of 1909.)

METHODS OF DETERMINING THE PRESENCE AND DIRECTION OF THE EQUALISING CURRENTS IN ALTERNATING-CURRENT APPARATUS. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 22,224. September 22nd.

ELECTRIC CONTACT DEVICES FOR USE WITH MOVING CONDUCTORS. W. G. Housekeeper. 24,911. October 26th. (November 3rd, 1909. Addition to No. 7,352 of 1910.)

REVERSING OF POLYPHASE ELECTRIC MOTORS. Siemens-Schuckertwerke Ges. 28,661. December 9th. (December 11th, 1909.)